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Speaking of Graphics

Chapter 6

Neurath and the Vienna Method of Picture Statistics

6.1 Life and work of Neurath

Otto Neurath was born in 1882 in Vienna in an intellectual family. He studied mathematics, history, sociology and economy. After completing his studies he taught at the economic high school in Vienna, traveled on behalf of the Peace Foundation in Eastern Europe and in 1919 headed the Central Planning Bureau of the short-lived communist 'Räterepublik' in Munich. (For his role in this political experiment, Neurath was subsequently convicted and sent to jail for a few weeks [1]). Otto Neurath is best known for his contribution to neo-positivist and empiricist philosophy. As already mentioned, he was an active member of the Vienna circle (Wiener Kreis) of neo-positivist philosophers. Their position represented a synthesis between logical analysis and empirical observation. They assumed that nature and society can lead to valid statements and predictions, which in turn produce changes in society. Neurath also participated in the movement for the unity of science of the Vienna circle. Together with Rudolf Carnap and Charles Morris he attempted to prepare an International Encyclopedia of Unified Science, which was proposed as a continuation and improvement of the French Encyclopédie of Diderot and d'Alembert [2] and of the work of the positivist philosophers Auguste Comte and Herbert Spencer [3]. The program of the neo-positivists was to unite the naive empiricism of Francis Bacon (1561-1626) with the logical disputation of scholasticism, without referral to the metaphysical principles of the idealistic philosophy of Hegel's school. Neo-positivism can be seen as a continuation of the work of Nicole Oresme, the fourteenth century natural philosopher, who first discussed mathematical, physical and economic questions in a modern, but still far from universal manner [4].

6.2 The Vienna method of Picture Statistics

The Vienna method of picture statistics represents a remarkable episode in the history of statistical graphics. It was an organized attempt to use graphical design for the purpose of achieving changes in society, primarily through visual education of the masses, and especially by presenting basic socio-economic facts in a readily comprehensible form. This was the program set forth by Otto Neurath, an Austrian sociologist and philosopher, and active member of the so-called Vienna circle which had a large influence on neo-positivist philosophy between 1930 and 1936 [5]. One of the leading ideas of the Vienna circle was that nature, as well as history, economy and society, could be described by the same methods. These should produce valid statements about space-time relationships that would lead to predictions which in turn could influence the course of events [6].

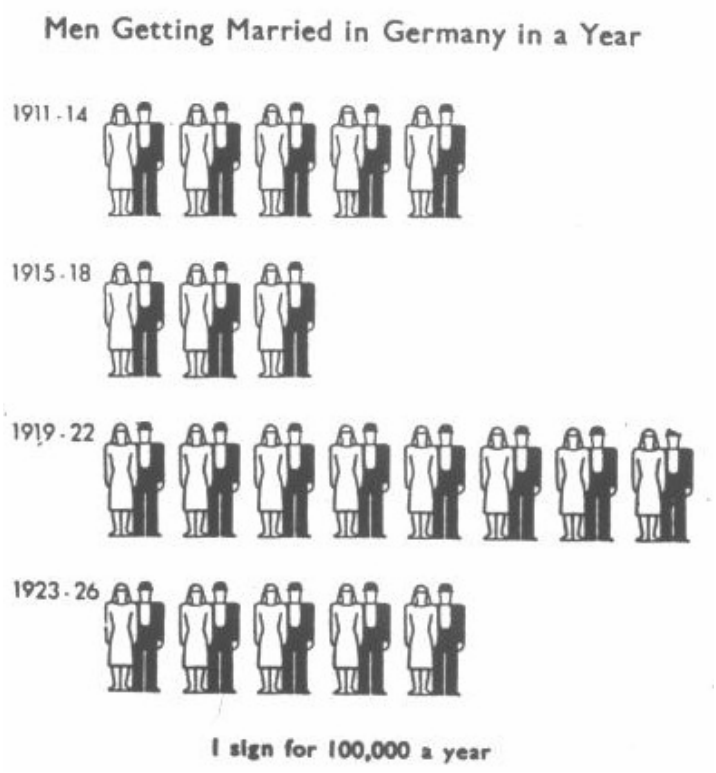

Figure 6.1. Marriages concluded in Germany during the period from 1911 to 1926, presented in the form of a picture statistic according to the Vienna method of Neurath. Each symbol represents 100,000 marriages in a year [7].

A characteristic of picture statistics according to Neurath's Vienna method is that numbers are represented by a series of identical pictorial elements or signs, each of them representing a defined quantity. A typical picture statistic is represented in Fig. 6.1, which shows the number of marriages in Germany in a given year for four consecutive 4-year periods. Each sign, which depicts a married couple, represents 100,000 marriages in a year [7]. The discrete character, the attractiveness and expressiveness of the picture elements are essential aspects of picture statistics. They can be transformed back into numbers by counting picture elements. This contrasts with the practice of present-day bar charts or histograms in which numbers are translated into lengths of continuous line segments, and in which the numbers are reconstructed from readings on a numerically divided scale.

Neurath vigorously rejected histograms with numerical scales, pie charts and graded symbols, as much as he disapproved of continuous line charts. He strictly adhered to counting of recognizable and suggestive signs. For comparison he represented the marriage statistics in the form of a histogram which is shown in Fig. 6.2 [8]. Notwithstanding the subdivision of the line segments in 'bricks' that could be counted, Neurath preferred the picture statistic for didactic reasons. While the histogram contains a greater amount of detail and provides data on a yearly basis, it is certainly more accurate than the picture statistic. The latter, however, has been designed to produce a lasting imprint on the mind, complementing the imprints left by other pictures. They are intended as teaching pictures. The design of the marriage statistic is such that one immediately apprehends the significance of the great war, in terms of a reduction of the number of marriages from 5 to 3 (hundreds of thousand marriages per year), followed by an increase to 8 in the four years after the armistice and a return to the previous level of 5 thereafter. The immediate impression is that 'lost' marriages due to the war are made good immediately thereafter.

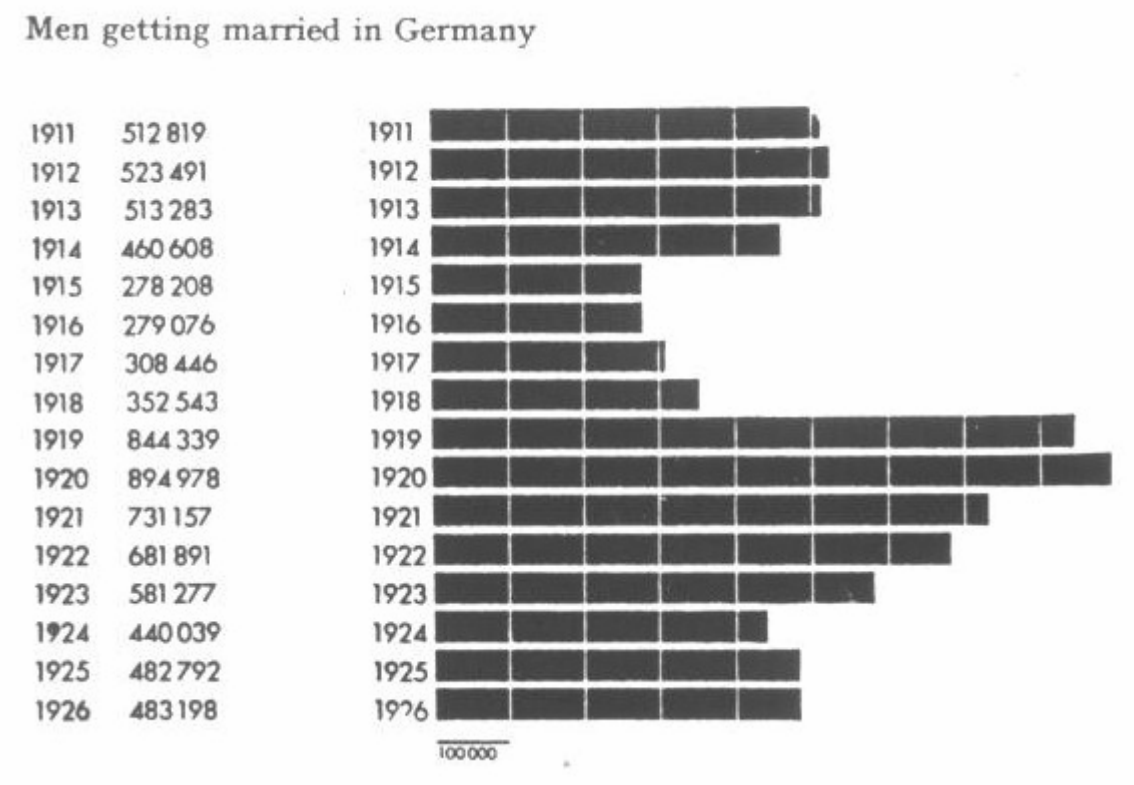

Figure 6.2. Marriages concluded in Germany during the period from 1911 to 1926 presented in the form of a histogram with countable bricks (but without a subdivided scale). Each brick represents 100,000 marriages in a year [7].The histogram is shown for comparison with the picture statistic of Fig. 6.1, the latter being preferred and recommended by Neurath for visual education of the population at large in socio-economic issues

6.3 Isotype, a pictorial language

Neurath also referred to his invention as education pictures and as fact pictures. His intention was to stimulate the mind of (in the first place) young people into active thinking, rather than passive assimilation of data. The picture statistics were designed to evoke questions. For example, was the age at marriage in the aftermath of the war lower than before in order to account for the increase in marriages? Was there a baby-boom after the Great War? What were the economic, sociological and psychological factors that accounted for the increase of marriages after the Great War? Clearly the picture statistic of marriages reminds us that we are dealing with people, rather than with abstract numbers. In order to achieve this goal Neurath

realized that good picture statistics are not only the work of a scientific researcher and graphic designer, but require an intermediate which he called 'transformer'. The task of the latter is to simplify complicated data by eliminating redundant and detracting details and to facilitate the task for the graphic artist. The leading idea was that it is better to keep to simplified images rather than to remember easily forgotten numbers [9]. A similar thought has been expressed by W. Playfair some 150 years earlier [10].

Neurath also conceived the idea of an international picture language, which would allow people all over the world to communicate and learn about important socio-economic issues in their past and present-day situation. This language was called Isotype, which is short for International System of Typographic Picture Education. In 1940, Isotype included 1,140 picture elements and a number of simple rules for combining them into pictorial sentences. A typical illustration of putting signs together in Isotype is given in Fig 6.3 [11]. In 1942, three years before his death, Neurath founded the Isotype Institute in England, for the promotion of his international picture language, mainly by means of educational books for youngsters.

Neurath almost devoted his entire life to the propagation of his ideas on visual education. He succeeded in associating first-class educators and artists to his life-time project. Notwithstanding the vicissitudes of the turbulent time during the ante-bellum and the second world war, Neurath succeeded in creating organizational forms for his project, first by the Gesellschafts- und Wirtschaftsmuseum in Vienna (from 1925 to 1934), then through the Foundation for the Promotion of visual Picture Education in The Hague (from 1934 to 1940) and finally in the Isotype Institute in Oxford (from 1942 until his death in 1945). Among his many outstanding collaborators, we only cite the statistician Alois Fisher, the educationalist Marie

Reidemeister, who was in charge of the 'transformation' department (and whom he married in 1941) and the artist Gerd Arntz, who headed the graphic department.

Unfortunately, Neurath's influence on statistical graphics lasted only for a few decades after his death in 1945. The reasons for the decline of the Vienna method are not yet clarified. Possibly, the labor intensiveness (both from an intellectual and practical point of view) proved to be prohibitive for large-scale application. The Vienna method was also designed primarily for exposition and education rather than for discovery and exploration (although the latter can be stimulated indirectly by picture statistics). This may have relegated picture statistics to more popularized and mundane ends, and averted the scholarly applications. It is possible that Neurath's social and political ideas met with resistance during the period of the cold war, and thus prevented the scientific development of his method. Nevertheless, his endeavor constitutes a distinctive landmark in the more recent history of statistical graphics. It is discussed here in greater detail, if only to keep alive the memory of the great contribution of Neurath and his associates to statistical graphics.

6.4 The Mundaneum and GeWiMu in Vienna

The distinctive aspect of Neurath's philosophy was his conviction that changes in society could only be achieved if the results of logical analysis were made available and accessible to large groups of the population by means of unified visual aids. Earlier attempts in this sense had been made by Johannes Comenius (1654) in his 'Orbis Pictus', which was meant for religious purposes and contained signs for many words in different languages. Gottfried Leibniz (1646-1716) also conceived of an Atlas Universalis (encyclopedia) containing pictures that were made according to scientific methods. The French Encyclopédie provided a large number of craftily engraved pictures, but there is only a loose connection between them [12]. In Brussels, Paul Otlet had founded the 'Cité Mondiale' for the distribution of printed materials and pictures. His design was to build museums of a new kind in major cities, which he called Mundaneums, i.e., museums of the development of mankind. Along the idea of the Mundaneum, Neurath founded in 1924 the 'Gesellschafts- und Wirtschaftsmuseum' (Social and Economic Museum, abbreviated as GeWiMu) and obtained permanent space at the municipal building in Vienna. At that time, the progressive social-democratic government of Austria looked benevolently upon Neurath's ideas for the creation of a new and modern mankind. The immediate objective of the GeWiMu was to inform the masses about sociological and economical issues and to provide them access to universal knowledge through 'education through the eye', chiefly by means of permanent and mobile exhibitions.

Isotype was the picture language designed by Neurath for this purpose [13]. It was most extensively used in 'picture statistics' (or fact pictures) for the representation of quantitative data and in 'education pictures' for the visualization of relationships from

the natural and sociological sciences. (Neurath considered history and economy as part of sociology.) This was stated in Neurath's own words: 'Isotype shows connections between facts without discussing them. Everybody, even one who is no scholar is able to take a scientific attitude and to regard calmly the Pilgrimage of Man - the life, fears and hopes of large groups of people.' [14]. 'The Isotype method may well become one of the elements which may help to bring about a civilization in which all men can participate in a common culture and in which the canyon between educated and uneducated will be bridged ... . We cannot hope to democratize cultural life without many new ways of conveying information.' [15]. 'Isotype is a kind of picture language intended for people of every kind throughout the world, young or old. But like all languages it needs a certain amount of thought to get the full meaning... . Begin by looking at each symbol, and then at all symbols ... till you thoroughly understand the statement made. Then ask yourself questions, many of which would, we feel sure, come into your mind ... . Then you will find big problems which will, we hope, send you to other books to find out more. In the same way, we hope that our charts will make you want to tell stories by pictures, using symbols like ours, or others which you could invent yourself.' [16].

When looking at picture statistics, one is compelled to think of the quipus and their use by the Incas in a society which lacked written language. Quipus may have served exactly the purpose envisaged by Neurath, although their use seemed to have been restricted to the upper ruling classes [17]. One may wonder whether Neurath realized that his enterprise could, depending upon circumstances, lead to oppression instead of liberation of mankind. Nowhere in his rules of Isotype is the integrity and unselfishness of the 'educators' questioned or put in doubt, although Neurath must have been aware of the danger: 'To make a picture is a more responsible work than to make a statement, because pictures make a greater effect and have a longer existence' [18]. (The grim face of government-directed

propaganda was only to become apparent during the last years of his life.) At the same time, he was optimistic about the desire of the masses to educate themselves, even during times of hardship and economic crisis, as evidenced by the following passage: '... it must not be concluded that life in terrible times is full of misery and oppression. If men cannot remove the cause of pain by direct means, they can often take refuge in friendship, love, poetry or faith on the one hand, and in the calm of a scientific research, liberty of thought and humanitarian effort' [19]. It is not surprising that Otto Neurath is sometimes referred to as a sceptic utopist.

6.5 The science and art of Picture Statistics

Apart from being a brilliant scholar with a broad outlook, Neurath also proved to be a practical organizer (and fund raiser). He realized that his project of 'universal education through the eye' could only be accomplished by bringing together a team of highly competent specialists. In 1926, Neurath first met with the German artist Gerd Arntz during an art exhibition in Dusseldorf. Arntz was born in 1900 in Remscheid (Rhineland) as the son of a manufacturer of iron hardware. He was educated as an arts teacher and specialized in wood cutting. In 1920 he took part in the insurrection of German laborers against the right-wing ‘Kapp-putch’ and adhered to the ideas of the 'Rätekommunismus' (which attributed a greater political role to the individual workers, at the expense of elected parliament and trade unions). His artistic and political involvement is evidenced by his testimony shortly before his death in 1988: 'According to my conviction that art must be related to society without emphasizing day-to-day politics, I have always maintained in my work the themes of war and opposition of the classes' [20]. Arntz's work consists of wood- and linocuts and is characteristic for the figurative-constructivist style which developed in the twenties and of which he was a renowned representative.

Initially, Arntz sent designs for picture graphics to Neurath in Vienna and, eventually in 1928, he moved to Vienna to head the graphic department of the GeWiMu. Although they may have agreed on political issues, it is amazing that Neurath and Arntz, individualists as they were, could get along together professionally. It took some effort on behalf of Arntz to convince Neurath to adopt his highly stylized picture elements. Arntz testified about his work: 'It was the case that artists, departing from naturalism, had to schematize, while I self departed from a primary form, a static figure, initially without arms and legs, which I developed later on in order to express

actions and social differences. From the beginning I had the difficult task to push through 'my style', also against a doubtful Neurath, who always, with his vivid and agile mind forever explored alternatives, when for me the solution 'from the inside so to say' was already decided upon'. And also: 'The clearer a subject is worked out, ... the more it elicits radical change of the position (of society) in present-day life' [21]. There can be little doubt that the characteristic graphic style of the Vienna method originated from the head and mind of Gerd Arntz. The GeWiMu also attracted other renowned artists who came to visit or work there for shorter periods. These included Peter Alma from Amsterdam, Augustin Tschinkel from Prague, students from the Bauhaus in Dessau, and Jan Tschichold who recommended the Futura letter type as the standard font for labels and texts on the education pictures.

The permanent staff of the GeWiMu included, among others, the statistician Alois Fisher, the Swiss artist Erwin Bernath, the cartographer Karl Peucker (who introduced an equal-area projection in geographical pictures), Marie Reidemeister and Friedrich Bauermeister. The latter two occupied a middle position in Neurath's organisation between the scientists and the artists: 'Turning the statements of science into pictures is frequently a delicate business and is not the work of a man of science or of a designer ... The first step from the statements of science to the pictures has a special name: 'transformation'.
The man of science has to make clear-cut statements on which other clear-cut statements in different branches of science may be based. The picture-maker has to be guided by the rules of education by the eye and to make a selection of material which will give a certain teaching effect, but it is not his purpose to give a full account of all facts... . The work has to be done by a group of experienced persons acting together: men of science, the teacher (the 'transformator') and men with a knowledge of designing, coloring, printing, pasting, etc.' [22].

6.6 The 12 rules of Picture Statistics

The GeWiMu hinged on three key processes of picture making: science, transformation and design with Neurath himself, Marie Reidemeister and Gerd Arntz as the chief representatives. Once the rules of the Vienna method were fixed, they were strictly adhered to. These rules can be summarized briefly as follows:

1. Picture statistics are designed to express amounts of the same thing or relations between amounts of different things. The number of repetitive signs should be countable, each sign expressing a given basic quantity (e.g., 1,000 people, 100 ships, 1 million tons of iron, etc.). A larger amount of something must be represented by a larger amount of signs, not by a larger sign. 'The eye is able to say: in that case the amount is 2 times greater than in another case.'
2. The signs should be highly stylized, endowed with the power to make them clear and pleasing to the eye. They should be used consistently, such that different pictures can be related to each other.
3. The selection of educational material is not simple. The one who can leave things out is the best teacher. Less is more. A simple picture kept in the memory is better than any number of complex ones which have gone out of it.
4. The 'transformation' of ideas in clear lay-outs is the next difficult step. The basic guidelines of transformation are to select, round off and arrange.
5. Graded symbols to express amounts should not be used. Graded circles and squares have no place in the system because their areas are difficult to compare.
6. Continuous lines for expressing the relationship between amounts and time should not be used. The individual points between two successive years have no meaning.

7. Color should be used consistently (e.g., green for farming, red for industry, blue for business).
8. Signs and colors are to be distributed over the plane of the picture in such a way that the attention is guided to certain points which have to be looked at first.
9. At the first look one should see the most important points, at the second, the less important points, at the third, the details, at the fourth nothing more - if you see more, the teaching picture is bad.
10. It is unnecessary to say in words what we are able to make clear by pictures. And on the other hand, it is frequently hard to make a picture of a simple statement. Education has to put the two together, and a system of education has to see which language is best for which purpose.
11. All pictures together make one unit, and it is important for the reader not to be troubled in any way if he is conscious of all the marks which teaching pictures have made on his memory.

    Neurath made a distinction between teaching pictures and advertisements [23]: 'Every business advertisement is in competition with every other and necessarily has the tendency to put all other such pictures out of memory of the onlooker. Every advertisement has to be different from others. This is not so with the teaching pictures.'
12. One has to be like another so far as it gives the same details, and to be different from another so far as the story it gives is different!

It should be noted that the scope of the Isotype rules reaches farther than picture statistics, which are only part of the broader class of education pictures. The former relate only to quantities, while the latter address general relationships between natural and sociological phenomena (including history and economy). The first important publication that was prepared by the GeWiMu according to the rules of the Vienna method was a statistical atlas entitled 'Gesellschaft und Wirtschaft' in 1930

[24], a pictorial account of human civilization and the factors that contributed to its development.

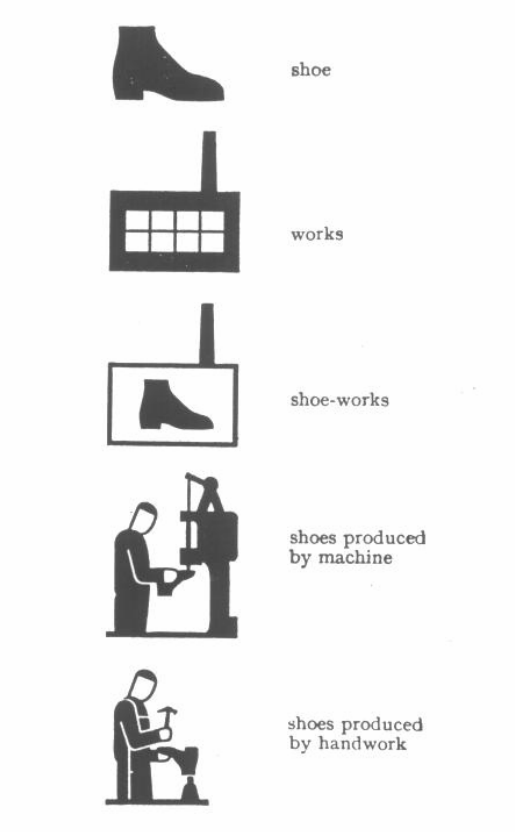

Figure 6.3. Putting signs together according to the rules of Isotype. The pictorial language possesses a rich contextual structure which allows to differentiate between 'making shoes in a factory' and 'making shoes by hand'. [11].

6.7 Modern Man in the Making

Due to the relentless efforts and enthusiasm of Neurath the method gained world-wide recognition. It was propagated further by Augustin Tschinkel in Tschechoslovakia, by Pfizner in Germany, by Peter Alma in the Netherlands and by Rudolf Modley in the US [25]. At the end of 1931 the Isostat Institute in Moscow was decreed by Stalin as the official source of social and economic statistics, which were to be presented according to the Vienna method. Arntz and other members of the GeWiMu travelled several times to Moscow between 1931 and 1934 in order to train designers, lino-cutters and statisticians in the practice of picture statistics. In this period Arntz also made contacts with Russian avant-garde artists such as Vladimir Tatlin and El Lissitzky who showed interest in the method. They were given generous support from the soviet government, and much of their work served to illustrate the achievements of the second five-year plan, the soviet air force, the new metro, etc. Picture statistics appeared regularly in the Pravda and Izvestia [26]. With hindsight, it is difficult to believe that Neurath was unaware of the propagandistic function of the Isostat Institute. In any case his relationship with Moscow was terminated in 1934, when some people of Isostat disappeared inexplicably and when payments became overdue.

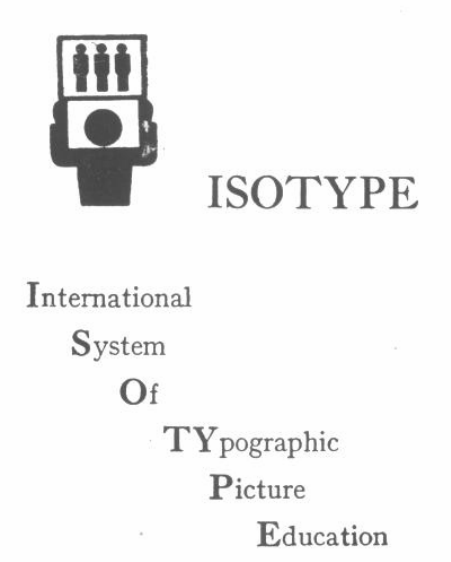

Figure 6.4. The Isotype logo which appeared on the picture statistics prepared by Neurath's Foundation for the Promotion of visual Picture Education and later by the Isotype Institute.

In the mean time the situation in Austria had changed drastically after the right-wing revolt by Dolfuss against the socialist Schutzbund in February 1934, which put an end to the social-democratic regime and to the operation of the Gesellschafts- und Wirtschaftsmuseum in Vienna. Because of the threatening situation in Vienna, Neurath, Arntz and Reidemeister emigrated to The Hague in the Netherlands, together with a small group of collaborators. From 1934 to 1940 they continued to work in the 'Foundation for the Promotion of visual Picture Education - Mundaneum The Hague', set up by Neurath. During his stay at The Hague, Neurath devised the name of Isotype (International System of Typographic Picture Education) as a substitute for the Vienna method (Fig. 6.3). The Isotype logo from then on appeared on all picture statistics designed by Neurath and his team (Fig. 6.4). Three important works appeared in this period at The Hague, namely 'International Picture Language. The first Rules of Isotype' [3], 'Modern Man in the Making' [14] and 'Basic by Isotype' [27]. The Foundation also produced panels about the life of Rembrandt and about the Dutch railway system for exhibitions in which the public could take active part.

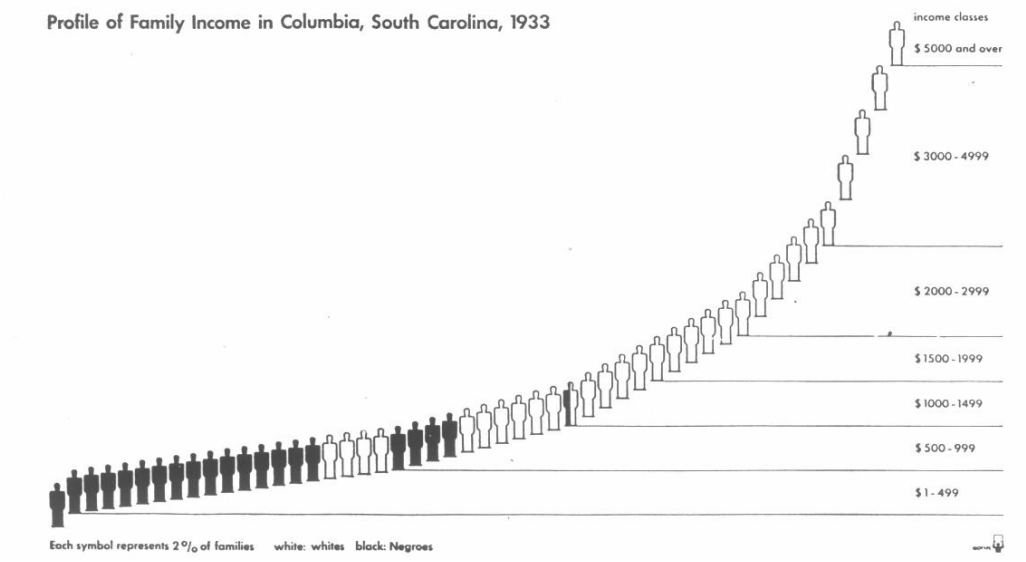

Figure 6.5. Distribution of family income in Columbia, South Carolina, in 1933 according to the Isotype method, from 'Modern Man in the Making', (1939). Each symbol represents 2% of families. Open and closed symbols provide a contrast between whites and blacks [14].

A typical picture statistic from 'Modern Man in the Making' [14] is the cumulative distribution of family income in the capital of South Carolina (in 1933) which is drawn according to the Isotype rules (Fig. 6.5). It is characteristic for Neurath's distaste for continuous lines and coordinate axes and for his insistence on discrete, suggestive and countable signs. The picture displays 50 signs, each of them representing 2% of families. The elevation of the signs is proportional to their level of income. Note the sign which is below the horizontal and which represents no income at all. The visual impression of higher status of people in higher income brackets is striking, as well as the contrast between white and black people. This diagram is also typical for Neurath's usage of picture statistics, which often reflect his moral values, socio-economic beliefs and educational intentions.

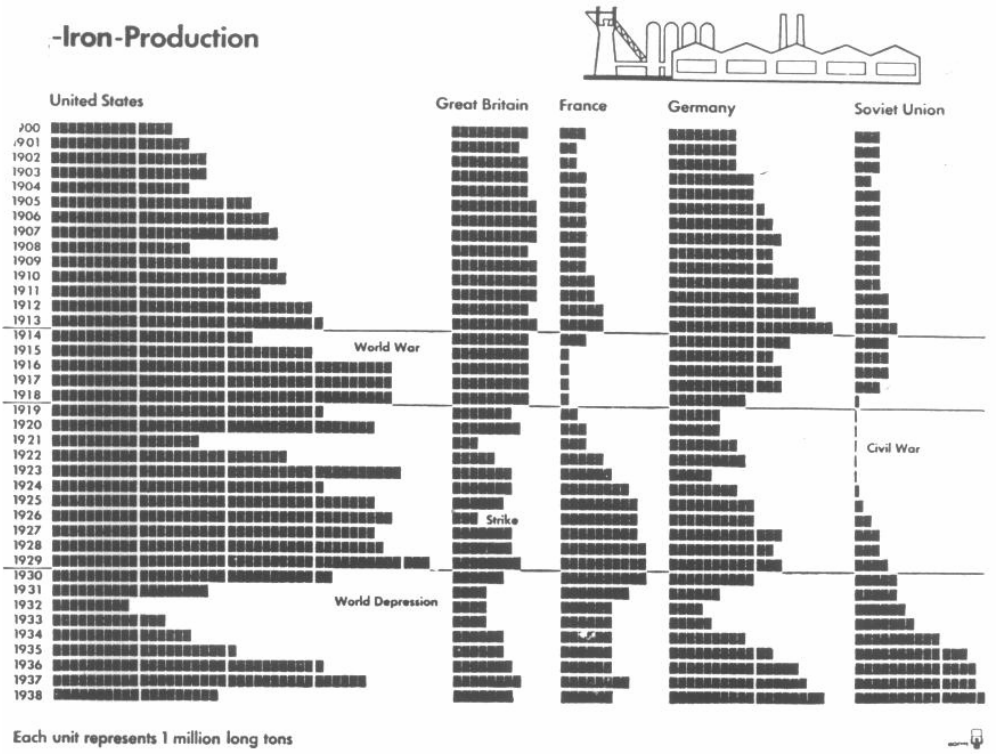

Figure 6.6. Production of pig iron in the US, Great Britain, France, Germany and the Soviet Union from 1900 to 1938 in the picture-statistic style of Isotype. Each unit represents 1 million long tons [14].

A remarkable aspect of a picture statistic is that it is capable of showing several dimensions of a situation without leading to confusion. The multidimensional nature of picture statistics is also apparent in the composite diagram (Fig. 6.6) of pig iron production in major industrialized countries from 1900 to 1938 [14]. Each brick in the picture represents 1 million tons. The eye is guided to historical episodes, notably the great war between 1914 and 1918 and the world depression which followed the financial crash of 1929. In the narrative to this picture statistic from Modern Man in the Making, attention is drawn on business cycles in individual countries and on international socio-economic relationships, such as the rearmament in Germany which affected production in other countries. The patterns in the free market economies of the US, Great Britain and France contrast with the plan economy in the Soviet Union after the civil war. They also contrast with the evolution in Germany after the seizure of power by Hitler in 1933.

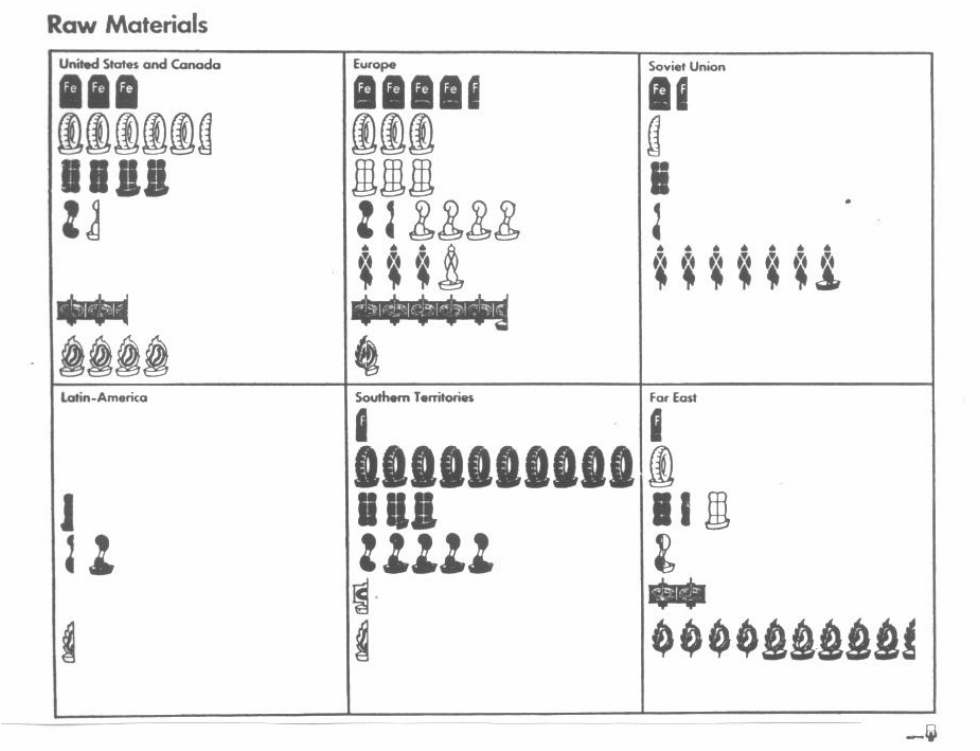

Figure 6.7 Production, import and export of raw materials in six world regions around 1935, according to the Isotype rules. Symbols represent (from top to bottom) pig iron, rubber, cotton, wool, linen, rayon and silk. Full symbols denote production in a given region, symbols on ships mean exported production. Outlined symbols refer to imported materials [14].

A highly multifaceted picture statistic from the same book describes the production, import and export of raw materials in six major world regions around 1935 (Fig. 6.7). The signs represent production of iron, rubber, cotton, wool, linen, rayon (viscose) and silk as they appear from top to bottom in each regional panel. Signs drawn in full represent production and those on ships denote the part of a country's production that is exported. Each full symbol represents 10% of the world production of the corresponding raw material. Outlined signs of ships indicate import from other regions. It is an interesting exercise to figure out, by eye, which region depended on which other region with respect to these raw materials. For example, Europe seemed to have been largely dependent on all imported natural textile materials, except linen. The larger importance of synthetic fibers (rayon) in Europe may be a consequence of this imbalance. In the US and Canada, textile requirements were covered by their

own cotton production and by imported silk. Synthetic production therefore, was less developed at that time. The Soviet Union had to rely almost entirely on its own production of linen, and possessed little variety in textile materials. Note that one arrives to such impressions merely by looking at the picture statistic, because the eye is capable to evaluate proportions without counting symbols consciously and without performing arithmetic operations. It seems as if different parts of the brain are involved when inspecting pictures and when dealing with tabulated numbers. Clearly the signs in a picture statistic are more evocative than bare numbers. The symbols representing rayon elicit considerations of industrial know-how and of natural resources (wood). Those representing silk evoke images of agricultural infrastructure and cheap domestic labor.

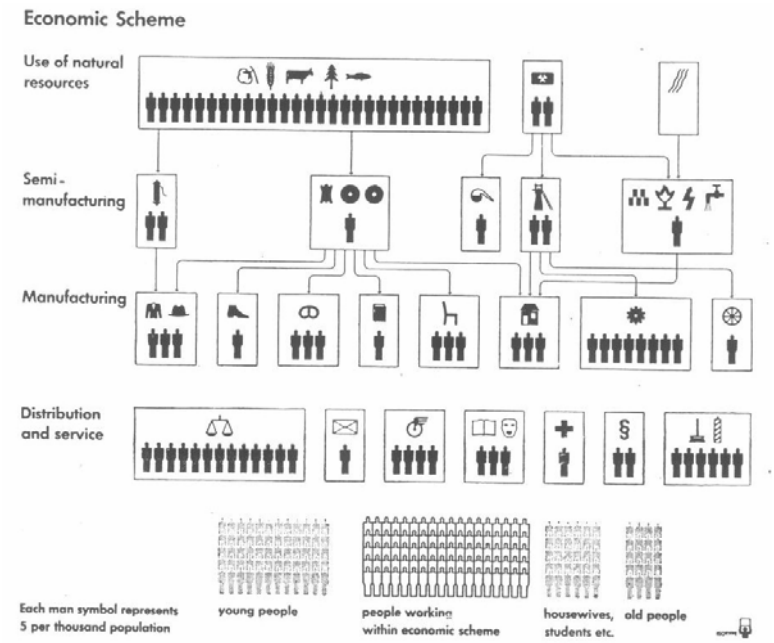

Figure 6.8. Schematic of economic interconnections between parts of society as viewed by Neurath in Modern Man in the Making [28]. In this Isotype picture statistic, each man represents 5 per thousand of the population. The upper part provides a breakdown of the active population by type of activity and accounts for 45 percent of the population (90 signs). The lower part gives the breakdown of the whole population (200 signs) into children, adults within economic schemes, adults not in economic schemes, and aged.

The economic scheme proposed by Neurath in Modern Man in the Making combines the elements of picture statistics with those of a flow diagram (Fig. 6.8). Each symbol represents 5 per thousand of the population. The upper part of this education picture divides the economically active population into four economic sectors, namely production of resources, heavy industry, manufacture of finished products and services. The Isotype diagram also shows the interconnections between the various sectors. For example, construction (housing) relies on wood and natural stone, metal products, bricks, gas, electricity and water works. Neurath commented: 'A bird's-eye view of the interconnections between all parts of a society in actions makes it possible to analyze the state of the world or the structure of a single country' [28].The economically active population is represented by 90 symbols for manpower, and this accounts for 45 percent of the total population. The lower part of the diagram puts this 45 percent of economically active workforce in the perspective of the other parts of the population, i.e., children, students and unpaid workers, aged people.

6.8 Gerd Anrtz and Marie Reidemeister

A hybrid use of Isotype pictures and tabulated data is exemplified in Fig. 6.9, which presents statistics on industrial enterprises of the German Reich in 1933, listing the number of enterprises and their corresponding number of male and female workers. The objective of this design is to make the table comprehensible even for non-German speaking individuals. It was published in the form shown here in the English edition of International Picture Language [29].

In the years preceding the World War II, Gerd Arntz produced woodcuts in which he warned for the imminent danger of fascism. An enlarged version of 'The third Reich' was sent in 1936, under the pseudonym of A. Dubois, to an exhibition in Amsterdam around the theme 'The Olympiad under Dictatorship'. It was removed from the exhibition, however, because it was thought to insult a befriended head of state [30]. When the German army invaded The Netherlands in 1940, Otto Neurath and Marie Reidemeister barely escaped to England by boat. They were married the following year. Neurath became professor at Oxford where he founded the Isotype Institute for the continuation of his work on education pictures and picture statistics. After his death in 1945, Marie Neurath assumed the direction of the Isotype Institute and published numerous books for children and large audiences on scientific, cultural and historical topics. The 'Visual History of Mankind' by Otto and Marie Neurath appeared in 1948 [31] in association with J.A. Lauwerys, professor of comparative education at the University of London, and with Lancelot Hogben, a popularizer of mathematics and a proponent of the social utility that mathematics should play in every day's life. Not everybody, in academic circles of England at that time, agreed with Hogben's thesis, however [32].

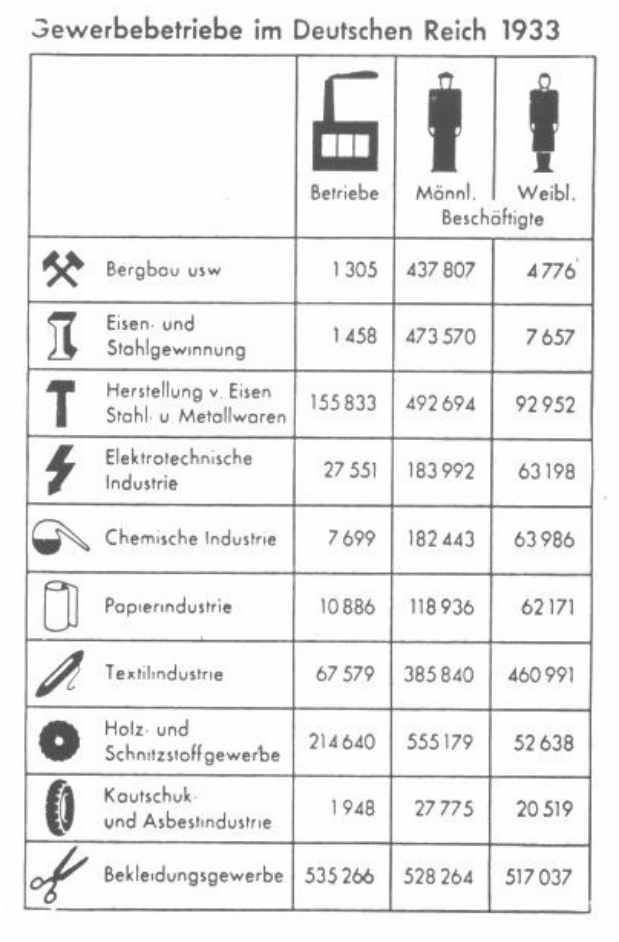

Figure 6.9 Table with labels translated in the Isotype picture language, describing industrial enterprises of the German Reich in 1933 in terms of numbers of enterprises and the corresponding numbers of male and female workers. The Isotype signs are intended to obviate the need for English translation of the row and column labels [29].

The work by Marie Neurath between 1948 and 1971 emphasized education pictures rather than picture statistics. She authored several series of popular picture books entitled 'They lived like this in ancient ... China, Africa, Crete, etc.', 'The wonder world of the ... jungle, universe, desert, etc.', 'Visual science' and several others, all published by Max Parrish in London and laid out according to the Isotype rules. Marie Reidemeister's work gained international recognition. She participated in educational projects for the government of West Nigeria. She contributed to the development of what is presently known as Infographics which has found a place in the daily papers and magazines. There also is a trend nowadays in scientific journals

to adopt education pictures, although in a looser form than prescribed by the Isotype rules.

After the departure of Neurath and Reidemeister from The Hague in 1940, Gerd Arntz was appointed graphic director of the Dutch Foundation for Statistics [33]. This organisation was created by Philip Idenburg, then director-general of the Central Bureau for the Statistics (CBS), with the specific objective to supply Dutch industry and government with picture statistics according to the Vienna method and the Isotype rules. By 1940, Arntz had compiled and catalogued 1,140 Isotype signs.

6.9 The Dutch Statistical Pocket Yearbook

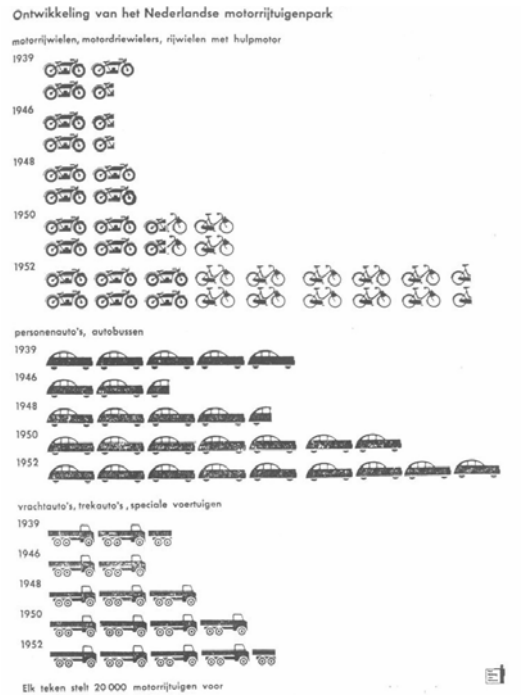

Figure 6.10. Picture statistic from the Dutch Statistical Pocket Yearbook of 1954. It represents the numbers of registered heavy and light motor cycles, cars (including buses) and trucks between 1939 and 1952. Note the negative impact of the war on the 1946 statistics, which was followed by a rapid increase thereafter. Each sign represents 20,000 vehicles. The logo on the right lower corner is that of the Dutch Foundation for Statistics [35].

During the period of 1940 to 1966, the Foundation for Statistics kept supplying picture statistics for the Statistical Pocket Yearbooks of the CBS under the guidance of Arntz, (except from 1943 to 1946 during which years he was drafted compulsively into the German army, surrendered to the French resistance and was kept as a prisoner of war after the liberation). The CBS picture statistics were often colored and integrated with the tabular material [34]. Figure 6.10 shows a typical amount picture for the number of registered motor cycles, bicycles, vans and trucks in the Netherlands for the period 1939 - 1952 [35]. The statistics can be read without much further explanation. (The effect of the war on the number of registered vehicles and the subsequent growth springs to the eye.) Part of a population pyramid is

represented in Fig. 6.11 which shows the distribution of boys and girls (left and right part) between ages of 3 and 25 years, together with their degree of school attendance [35]. Full symbols represent students enrolled full-time or part-time in education, open circles represent youths outside the educational system. Note the difference between boys and girls with respect to the ages at which they leave school. The maximal age at which all children attended school appeared to be 13 years in the Netherlands of 1954. This is an illustration of what Edward Tufte more recently called 'small multiples', i.e., the repetitive use of elementary signs to create a global impression [36].

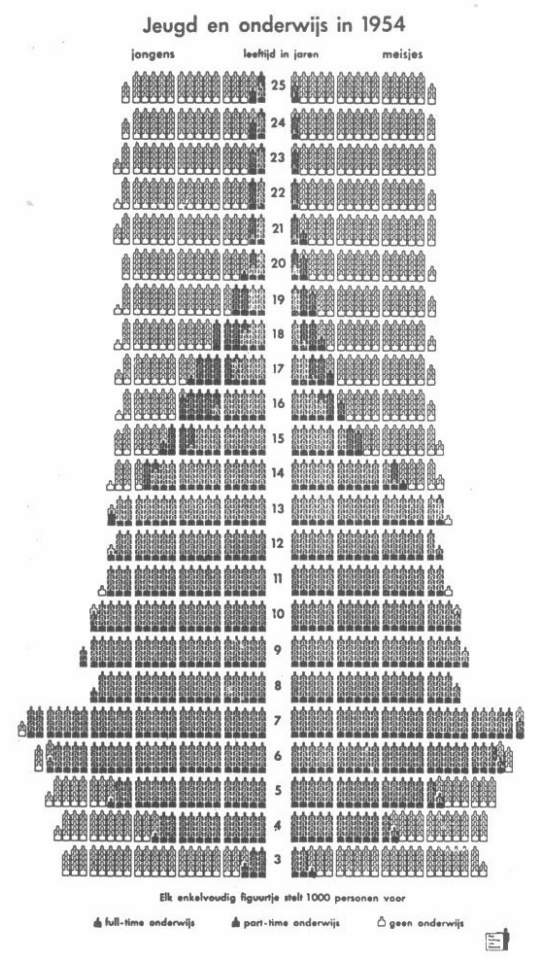

Figure 6.11 Picture Statistic from the Dutch Statistical Yearbook of 1956. It displays the distribution in 1954 of children and youth according to gender, age and enrolment in part-time and full-time education schemes as indicated by the filled signs. Outlined symbols indicate no participation in education schemes. Each sign represents 1,000 individuals [35].

A multi-factorial type of picture statistic is represented in Fig. 6.12 which displays the number of graduates from secondary schools with respect to the factors of time (from 1939 to 1960), type of school (high school or vocational school), division within school (α, β or A, B) and gender (boy or girl) [35]. The Dutch statistical yearbooks also contained an occasional flow diagram such as the one in Fig. 6.13, which displays the production and consumption of coal, gas and cokes. The various sources and destinations are clearly outlined in the flow diagram, including import of coal (top), own consumption by the suppliers (left), export (bottom) and final consumption (right) [35]. Such flow diagrams are reminiscent of those produced by Charles Minard about 100 years earlier for the display of economic and historical data [37].

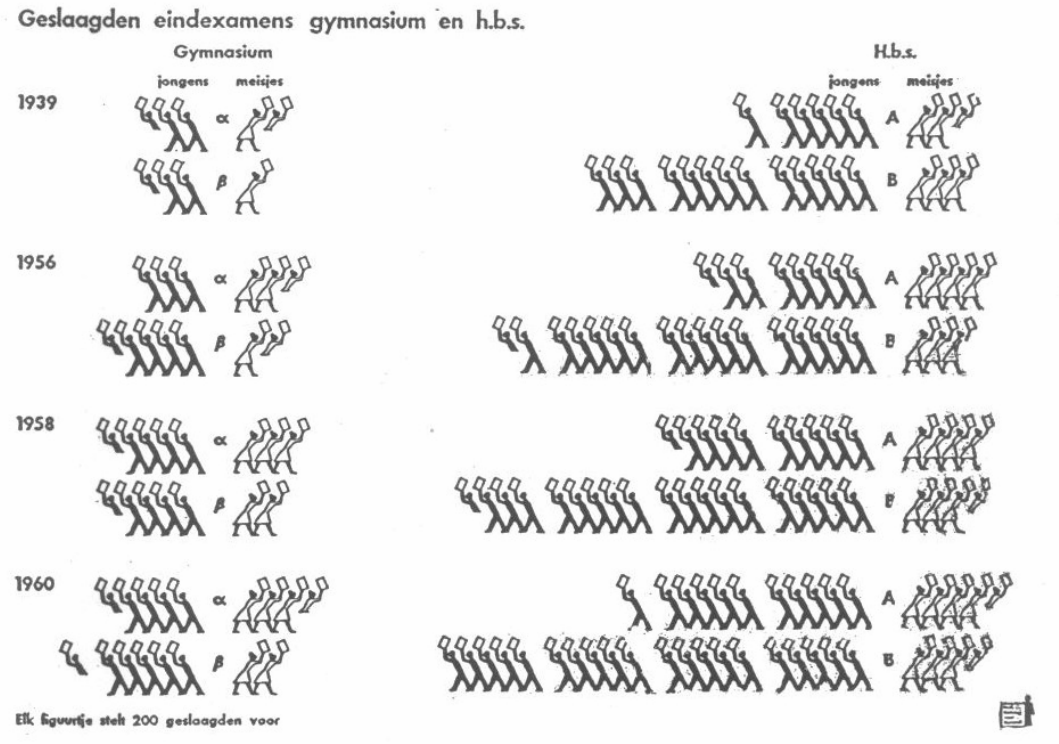

Figure 6.12 Picture Statistic from the Dutch Statistical Yearbook of 1962. It shows the number of graduates from high school and vocational schools, according to gender, year of graduation between 1939 and 1960 and type of diploma (□ and □ for high school, A and B for vocational school) [35].

6.10 The decline of the Vienna Method

In 1966 Philip Idenburg retired as director-general from the CBS and this marked the end of the co-operation between the Foundation and the CBS [38]. The pocket yearbook of 1967 still contained some picture statistics, designed by the CBS itself, but these were appended at the end of the volume together with a number of traditional bar charts and line diagrams. The year thereafter, picture statistics disappeared altogether from the yearbooks. Gerd Arntz died in 1988 at the age of 88, after an eventful but fruitful life as a political idealist, graphic artist, designer of Isotype symbols and producer of picture statistics according to the Vienna method.

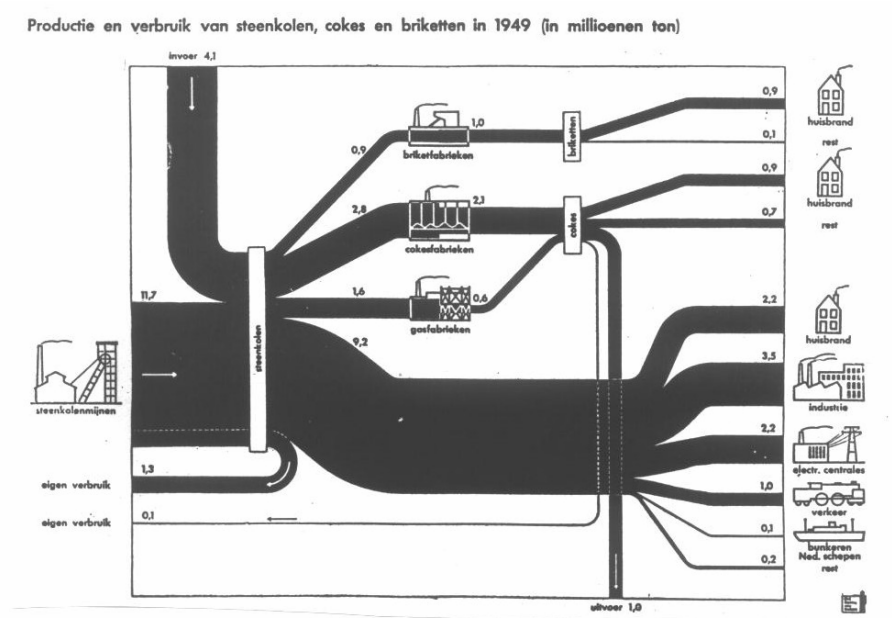

Figure 6.13 Flow diagram, according to the Isotype rules, illustrating the Dutch production and consumption of coal, gas and cokes in 1949. The thickness of the flow lines is proportional to the annual production which is expressed in million tons. National production of coal originates in the diagram from the left, import enters from the top, export flows out at the bottom and consumption emerges at the right. Coal is also transformed into gas and cokes. A fraction of the production of coal and gas flows back to support the primary production process. From the Dutch Pocket Yearbook of Statistics. [35].

Although the influence of the Vienna method is still felt indirectly, for example in the use of signs by the Dutch railway system, the contributions of Neurath, Reidemeister,

Arntz and their collaboration seem to be largely forgotten. One may speculate why the Vienna method and the Isotype style have been abandoned after 28 years of continuous usage in the official Dutch statistical publications. Maybe it was realized that the production was labor-intensive and therefore becoming prohibitively expensive. Perhaps, the support of Philip Idenburg was a decisive element in the adoption of the Isotype system by the CBS. His keen and lifelong interest in educational matters may have contributed to his predilection for the Vienna method. He was awarded a professorship of educational sciences at the University of Amsterdam, served in official functions of educational institutions and contributed many publications on this subject [38]. As we have mentioned before, it is not unthinkable that the political climate in the Western world became unfavorable for a further development of the Vienna method as a result of the cold war in the sixties and in view of the involvement of their creators in the 1930's left-wing movements in Germany and Austria and their association with soviet propaganda in Russia.

The fate of the Vienna method and of Isotype has not been much different in England from that in Austria and the Netherlands, notwithstanding the efforts by Marie Reidemeister after the death of her husband. Here emphasis had shifted from statistics to education, particularly of children. Perhaps, the association with so-called left-wing educationalists (such as Lancelot Hogben) did not help in the end. A collection of Isotype designs is presently kept at the University of Reading [39]. In the US, Rudolf Modley continued to promote pictograms and signs more or less inspired by the Vienna method [40]. Some of its influence may be still felt in the use of graphic illustrations in daily papers and financial journals, although many of these contradict the basic rules of Isotype and of picture statistics laid down by Neurath.

Now that the protagonists of the epos of the Vienna method have disappeared and most of the context in which it was developed has faded away, it is time to re-

evaluate its merits, its strengths and weaknesses. Many of its ideas may be worth picking up again, although in a transformed, looser and less dogmatic form. Certainly it would do justice to the creators and designers of the Vienna method, Isotype and picture graphics for their memory to be revived and honored.

Notes

[1] Cornelis Veenstra, De Weense Methode (The Vienna method). Presumably an internal report of the Centraal Bureau voor de Statistiek (CBS), Voorburg (Nl), not dated (in Dutch).

[2] International Encyclopedia of Unified Science. (Otto Neurath, Rudolf Carnap, Charles Morris, Eds.), Vol. I, nr. 1-5, The University of Chicago Press, Chicago, Ill., 1938, with a contribution by Neurath entitled 'Unified Science as Encyclopedic Integration' and with chapters by Niels Bohr, John Dewey, Rudolf Carnap and Charles Morris.

[3] Otto Neurath, Unified Science as Encyclopedic Integration. In: International Encyclopedia of Unified Science, Vol. I, Part I. Opus cit.

[4] See the chapter on Oresme and Descartes in this book, for a more extensive discussion of the early predecessors of statistical graphics.

[5] The Vienna circle (Wiener Kreis) was founded by the philosopher Moritz Schlick and was active between 1929 and 1936. Apart from Neurath it included Rudolf Carnap, Kurt Gödel and several others. It was the principal drive behind neopositivism, also called logical empiricism or empirical rationalism. It has influenced the English school of logical positivism (represented by Ludwig Wittgenstein, Bertrand Russell and George Moore).

[6] Otto Neurath, Empirische Sociologie, 1931.
Otto Neurath, Foundations of the Social Sciences. 1944.

[7] Otto Neurath, International Picture Language, The first Rules of Isotype. Kegan Paul, London, 1936, p.77.

[8] Ibidem p.76.

[9] Kees Broos, The Viennese method for pictorial Statistics. Otto Neurath and Gerd Arntz. Text prepared for the centenary session of the International Statistical Institute (ISI) in August 1985 in Amsterdam, at which occasion G. Arntz was honored for his contribution to picture statistics and Isotype. At this occasion, some 12 exquisitely designed panels were exhibited, showing photographs, reproductions from books and other historical documents related to the 'Vienna method' of pictorial statistics. The exhibition was prepared by Adelbert Foppe and Flip H. Bool of the Haags Gemeentemuseum. The panels are presently kept in the archives of the Central Bureau for Statistics (CBS) in Voorburg (Nl), which patronizes the ISI. An extended version of the text was previously published in:
Gerd Arntz, Critical graphic Work and picture Statistics. Haags Gemeentemuseum (Kees Broos and Flip Bool Eds.), Sun Publ., Nijmegen (Nl), 1976 (in Dutch).

[10] William Playfair, The Political and Economical Atlas. London, 1786.
Playfair referred to: 'great lines of force' and 'images that remain unimpaired in the mind for a long time'. See also the chapter on Playfair in this essay.

[11] Otto Neurath, International Picture Language. The first Rules of Isotype. Opus Cit., p.51.

[12] Otto Neurath, International Picture Language, The first Rules of Isotype. Opus cit., pp. 107-109.

[13] The name ISOTYPE (International System for Typographic Picture Education) has been given to the Vienna method by Neurath probably after 1934 during his stay at The Hague. It is introduced here, because most of the quotes and excerpts are from Neurath's publications during the Isotype period.

[14] Otto Neurath, Modern Man in the Making. Secker and Warburg, London, 1939, pp. 7-8.
This work also appeared in the US, England, the Netherlands and Scandinavia. It contains 100 illustrations in 7 colors. It is the last work on which Otto Neurath and Gerd Arntz have co-operated. It is also the most beautiful and comprehensive illustration of the Vienna method.

[15] Ibidem, p. 136.

[16] Otto and Marie Neurath, J.A. Lauwerys, Visual History of Mankind. (Lancelot Hogben, Hon. Ed.), Max Parrish, London, 1948.

[17] See also the chapter on quipus in this essay.

[18] Otto Neurath, International Picture Language, The first rules of Isotype. Opus cit., p. 15.

[19] Otto Neurath, Modern Man in the Making. Opus cit., p. 130 .

[20] Gerd Arntz, De Tijd onder het Mes (Time under the scalpel. A biography and overview of his graphic work). Sun Publ., Nijmegen (Nl), 1988 (in Dutch).

[21] Cornelis Veenstra, The Vienna Method. Opus cit.
Kees Broos, The Vienna Method for pictorial Statistics. Opus cit.

[22] Otto Neurath, International Picture Language. The first Rules of Isotype. Opus cit., pp. 7-8 and pp. 28-32.

[23] Ibidem, p. 28.

[24] Otto Neurath, Gesellschaft und Wirtschaft. Bildstatistisches Elementarwerk des Gesellschafts- und Wirtschaftsmuseums in Wien (Society and Economy. Basic Picture Statistics Book of the Social and Economic Museum in Vienna). Leipzig, 1930.
This work already shows the unifying influence of the graphical standards imposed by G. Arntz. It followed an earlier compilation of picture statistics which was designed in different styles and by differently inspired artists: Otto Neurath, Die bunte

Welt - Mengenbilder für die Jugend' (The varied World - Amount Pictures for Youngsters). Wien, 1929.

[25] Rudolf Modley, How to use pictorial statistics. New York, 1937.

[26] Cornelis Veenstra, The Vienna Method. Opus cit.

[27] Otto Neurath, Basic by Isotype. Psyche Miniatures (C.K. Ogden, Ed.), General Series nr. 86, Kegan Paul, London, 1937.
C.K. Ogden was director of the orthological institute at Cambridge and author of: The ABC of Basic English, English Step by Step, Kegan Paul, London, year not known. The connection between Basic English and Basic by Isotype is not fortuitous as the book itself is composed in BASIC English using only 850 English words. The journal Psyche also presented an annual review of general and applied psychology, edited by Ogden, with contributions by Alfred Adler, Lancelot Hogben, Cyril Burt, Rudolf Carnap, Bertrand Russell and others.

[28] Otto Neurath, Modern Man in the Making. Opus cit., p. 65.

[29] Otto Neurath, International Picture Language. The first Rules of Isotype. Opus cit., p. 23. The contents of this table will be displayed as the result of a factor analytic method in one of the chapters on multivariate analysis in this essay.

[30] The Organizing Committee, Gerd Arntz and the Vienna Method for Picture Statistics. Proceedings of the Workshop on Statistical Software of the Dutch 'Vereniging voor Statistiek', Utrecht, 1989. Reference is made in this editorial article to the work of K. Broos and F. Bool which have been cited above [5].

[31] Otto and Marie Neurath, J.A. Lauwerys, Visual History of Mankind. Opus cit.

[32] Pure mathematicians repudiated Lancelot Hogben's position. G.H. Hardy (professor of mathematics at Cambridge) criticized the 'shallowness of the current left-wing Lancelot Hogben interpretation of mathematics in terms of social and economical utility. ... It is not possible to justify the life of any genuine professional mathematician on the ground of utility of his work'. The quote is from:
Andrew Hodges, Alan Turing, The Enigma. Burnett and the Hutchinson Publ. Group, London, 1983, p. 120.
The author implies that seemingly 'useless' abstract work (such as on computable numbers and on the so-called Entscheidungsproblem) of Alan Turing had more far-reaching consequences for the world than Lancelot Hogben's restriction of mathematics to its more elementary and mundane applications.

[33] In Dutch 'Stichting voor de Statistiek'. The organization now operates under the name Marktonderzoek B.V. in The Hague, but it is no longer involved with picture statistics and the Vienna method.

[34] Statistisch Zakboek (Statistical Pocket Yearbook). Central Bureau for the Statistics (CBS), W. De Haan, Utrecht, 1940-1966 (in Dutch). Each yearbook contained about 25 picture statistics.

[35] Picture statistics from the Statistical Pocket Yearbook of the Dutch Central Bureau for the Statistics, Opus cit., 1953-1962 . Note that Arntz provided the pictures with the logo of the Dutch Foundation for Statistics (Vereniging voor Statistiek) rather than with the Isotype logo, which probably had been reserved by the Isotype Institute in England.

[36] Edward R. Tufte, The visual Display of quantitative Information. Graphics Press, Conn., 1983, p. 170-175.

[37] Charles Joseph Minard, Tableaux graphiques et Cartes figuratives de M. Minard 1845-1869. Bibliothèque de l'Ecole Nationale des Ponts et Chaussées, Paris.
Some of Minard's flow diagrams are reproduced in:
Edward Tufte, The visual Display of quantitative Information. Opus cit., pp. 25 and 176.

[38] Prof. Dr. Philip J. Idenburg. Director-general of the statistics, 1939-1966. A biographical and bibliographical publication by the CBS on the occasion of his retirement, The Hague, 1966 (in Dutch).

[39] The Otto and Marie Neurath Isotype Collection. Department of Typography and graphic Communication, University of Reading, England.
A selection of Isotype designs has been republished in:
Peter Wildbur, Information Graphics. Trefoil Publ., London, 1989.

[40] Rudolf Modley, Pictographs and Graphs: How to make and use them. Glyph Inc., New York, 1952.

Biographical Notes

Otto Neurath (1882-1945)
Sociologist and philosopher, logical empiricist, organizer of the Vienna circle, inventor of the Vienna method for picture statistics and of Isotype, a picture language.

Gerd Arntz (1900-1988)

Graphic artist, socially and politically inspired, designer of the picture elements for the Vienna method and Isotype.

Marie Reidemeister
Educationalist, transformator of statistical data into picture elements.

1925-1934	Organization of the Gesellschafts- und Wirtschaftsmuseum (GeWiMu) in Vienna.
1928	Permanent association of Neurath with Arntz in Vienna.
1929	Active participation in the Vienna circle (Wiener Kreis) of neo-positivist philosophers.
1930	'Die Bunte Welt', a motley collection of picture statistics in different styles. 'Gesellschaft und Wirtschaft', a statistical atlas according to the Vienna method, produced under the supervision of Arntz.
1931	'Empirische Sociologie'. The Vienna method is decreed as the official statistical method in Russia. Foundation of the Isostat Institute in Moscow. Regular visits of Arntz to Moscow until 1934.
1934	After closure of the Gesellschafts- und Wirtschaftsmuseum, transfer to The Hague in the Netherlands with Arntz, Marie Reidemeister and others.
1936	'International Picture Language. The first rules of Isotype'.
1937	'Basic by Isotype'.
1938	'International Encyclopedia of Unified Science'. Foundation for the Promotion of visual Education and the Mundanaeum Institute, The Hague.
1939	'Modern Man in the Making'.

1940 After German occupation of the Netherlands, Neurath escapes to England with Marie Reidemeister. Arntz remains in The Hague and becomes graphic director of the 'Stichting voor Statistiek', founded by Ph. Idenburg, then director of the 'Centraal Bureau voor de Statistiek (CBS)'. The Stichting contributes picture statistics for the Statistical Pocket Yearbooks of the CBS from 1940 to 1966.

1941 Neurath becomes professor at Oxford. Marriage of Neurath by Marie Reidemeister.

1942 Foundation of the Isotype Institute in Oxford.

1944 'Foundation of the social Sciences'.

1945 Neurath dies.

1948 'Visual History of Mankind' by Otto and Marie Neurath. Between 1948 and 1971, Marie Neurath produces children's books and educational texts using Isotype.

1950 'Visual Science' by Marie Neurath.

1951 Arntz contributes picture statistics to UNESCO until 1962.

1953 Marie Neurath participates in an educational project in West Nigeria.

1965 Arntz retires from the 'Stichting voor Statistiek'.

1966 Idenburg retires from the CBS. Picture graphics disappear from the Statistical Pocket Yearbook after 1967.

1988 Arntz dies.
