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## Global AIDS Epidemics: Graphic Documentation of Spread

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Acquired Immunodeficiency Syndrome (AIDS) was first described in 1981 after homosexual men in 1980/1 in Los Angeles were found to be suffering from an extremely rare type of pneumonia caused by a protozoan, *Pneumocystis carinii* (CDC, 1981). This was followed by reports from New York and California of a rare type of cancer known as Kaposi's sarcoma. It was previously only seen in elderly men and patients receiving immunodepressive therapy. Finally, reports of chronic lymphadenopathy and of non-Hodgkin's lymphoma were seen in young homosexual men, suggesting an impaired immune system. Since 1981 these cases have been reported to the Centers for Disease Control (CDC) in Atlanta, Georgia, USA (HEYWARD & CURRAN, 1988). AIDS was seen in Africa and Haiti shortly thereafter, and it was recognized as a rapidly spreading international epidemic (GRMEK, 1989) with first sporadic cases also in Europe. Human Immunodeficiency Virus (HIV), the etiologic agent, was identified in 1983, and within a year a test based on antibodies to the virus was available (GALLO & MONTAGNIER, 1988).

Still in the early eighties, the World Health Organization (WHO) started to receive the first AIDS notifications from various member countries. A systematic notification system was developed in collaboration with WHO regional offices, governments and specialized agencies and institutions. By 1 April 1990, 237 110 AIDS cases from 153 countries had been reported (out of 177 reporting countries), while WHO estimates over 600 000 cases to have occurred to this date (WHO, 1990a; CHIN, 1990). Estimates of HIV infected persons are put at this time at around 6–8 millions. However, already by end of 1991, WHO estimates that around 1,1 million AIDS cases will have occurred (SATO et al., 1989; CHIN et al., 1990). Also by 1 April 1990, the Canton Fribourg had 17 reported AIDS cases, Switzerland 1255 (FOPH, 1990).

We now know that there are only three ways in which the disease is spread: sexual intercourse, blood and blood products, including contaminated needles of intravenous drug users (IVDUs), and perinatal transmission from mother to newborn (CHIN et al., 1989).

### AIDS patterns

WHO has distinguished three epidemiologic patterns of the AIDS epidemic (MANN & CHIN, 1988). *Pattern I* is found in North America, Western Europe, Australia, New Zealand and in some urban areas of Latin America. In Pattern I-areas, sexual trans-

mission of HIV occurs principally among homosexual and bisexual men and an increasing number of intravenous drug abusers. A few women are infected so far, pediatric infection is uncommon but growing.

*Pattern II* is found in sub-Saharan Africa and increasingly in Latin America, especially in the Caribbean, regions where HIV transmission is mainly heterosexual. Up to 25% of sexually active adults in some urban areas and frequently a majority of female prostitutes (KREISA et al., 1986) are infected. In the absence of adequate screening facilities, transmission through blood transfusion is inevitable and has remained a major concern to South and North. HIV infection is equally distributed by sex, and perinatal transmission is a major problem. Because of their shorter incubation period, the cumulative pediatric AIDS cases can be disproportionately high compared to the total number in a rapidly growing AIDS epidemic (CHIN et al., 1989; CHIN et al., 1990).

*Pattern III* includes North Africa, the Middle East, Eastern Europe, Asia and the Pacific where HIV infection has not yet spread to the general population and prevalence of infection is low. However, there is recent evidence of spread among prostitutes and intravenous drug abusers in some countries, such as Thailand (CHIANUPAK et al., 1989).

### **AIDS peak of the HIV iceberg**

The Surveillance, Forecasting and Impact Assessment Unit (SFI) of the WHO Global Programme on AIDS (GPA) has responsibility for global monitoring of both HIV and AIDS. This worker is concentrating on the surveillance of morbidity, that is the «AIDS peak of the HIV iceberg». Although reports to WHO are admittedly incomplete, especially in some developing countries, these reports are the most useful in describing patterns and trends of spread of this deadly disease. The epidemiography of AIDS serves many purposes, including as input into model calculations in specialized institutes. The reports to WHO, updated monthly (WHO, 1990a) are not only the basis for the overview of this pandemic to date, but constitute a very fine methodological challenge to «display documentation» – a school of thought/work close to medical history (BERNARD, 1989a). AIDS FEEDBACK (AF) fascicules are meant to be an interdisciplinary work and documentation tool for tight reasoning and hypothesis formulation, among others.

### **AIDS FEEDBACK – Status 1 April 1990 (AF 03 90)**

AF 03 1990 was issued in April 1990 (BERNARD, 1990). The 20 documented modules constitute a detailed review of the reporting situation at the end of the 1st quarter of 1990. Eight modules are given here, with a brief access description.

*Figure 1* shows the global growth of reported AIDS cases diagnosed through 1988 as received at WHO by 1 April 1990 («reporting grace period of 15 months»). Each year there are much more new cases than in the previous year. In this way, 39,4% of all cases through 1988 (N=171 150) occurred actually in 1988. These 67 480 reported cases

assigned to 1988 are more than all cases reported through 1986 (N=54 781). This explosive growth can be quantified by calculating annual excess of new AIDS cases over the previous year. The 1988 over 1987 new AIDS cases yield an excess of 38% (67 480/48 889). Methodology is currently being developed to display trends of annual percent change by AIDS pattern, world region, state and state subdivisions (see Fig. 8).

The cumulative occurrence of diagnosed AIDS cases by calendar year and continent is shown in *Figure 2*. The dual coordinate system guides the reader in the understanding of this world view («AIDS growth grid»). The semilog plot (amount by time) carries an oblique coordinate system of 1 year doubling time (DT) of the cumulative incidence. As an example: 1986 was the first year for North America not quite to double incidence – the curve starts to approach the doubling coordinate system from above; the same «event» occurred in Europe 2 years later. Since these two world regions are thought to have the most complete reporting (still 10–30% off), the observation is considered important. The 1989 figures will allow to confirm and refine the previous epidemiological finding. Completeness in reporting is thought to be of lower level for both Latin America and Africa in particular. WHO has made estimates of actual AIDS cases which are shown for sub-Saharan Africa from 1986 to 1988 (CHIN, 1989). These estimates lie higher than all cases reported from around the world (by end 1988: 260 000 vs 171 575). The highest number of AIDS cases pertains thus to Africa, and, indeed, reported cases show the most rapid growth. For 1988, Africa's cumulative incidence doubling time was much shorter than 1 year, although there remain still 6–7 unreported cases for each estimated occurred case.

The end-1983 cumulative AIDS case rates per million population are displayed in *Figure 3* for the Americas and Europe. It strongly suggests the pattern of early spread being from the Caribbean to North America to Central America to South America with a transatlantic transfer following rapid transportation from North America to Europe (BERNARD & KESSEL, 1989b). The early spread to Belgium, however, is thought to be by patients seeking treatment from francophone central Africa (CLUMEK et al., 1983, 1984; SONNET & DE BRUYERE, 1983).

The global distribution of reported AIDS cases is changing dramatically as seen in *Figure 4*. While the percent share of the Americas is decreasing, Africa's percent share increases steeply, Europe's share more discreetly. Africa's dramatic increase has most likely to do with improved reporting and a general tendency for new epidemics to increase most rapidly.

REPORTED AIDS CASES ASSIGNED TO CALENDAR YEARS 1982 - 1988

ANNUAL NUMBER, PERCENT & CUMULATION, PERCENT CHANGE

1 APRIL 1990 AIDS REPORTING STATUS TO WHO/GPA/SFI

TREND  
1980s  
1  
AF 03 90

	ANNUAL		CUMULATIVE		ANNUAL PERCENT CHANGE (y/y-1)
	NUMBER (82-88)	PERCENT (82-88)	NUMBER (82-88)	PERCENT (82-88)	
1988	67,480	39.4	171,150	100	
<hr/>					
FIRST 100'000 REPORTED AIDS CASES					
1987	48,889	28.5	103,670	60.6	+38.0
1986	27,841	16.3	54,781	32.1	+75.6
1985	14,894	8.7	26,940	15.8	+86.9
1984	7,310	4.3	12,046	7.1	+103.7
1983	3,548	2.1	4,736	2.8	+106.0
1982	1,188	0.7	1,188	0.7	+198.7
(...1981		425)			

GE rb AF 18 Apr 1990

Fig. 1: Reported AIDS cases assigned to calendar years 1982-1988.



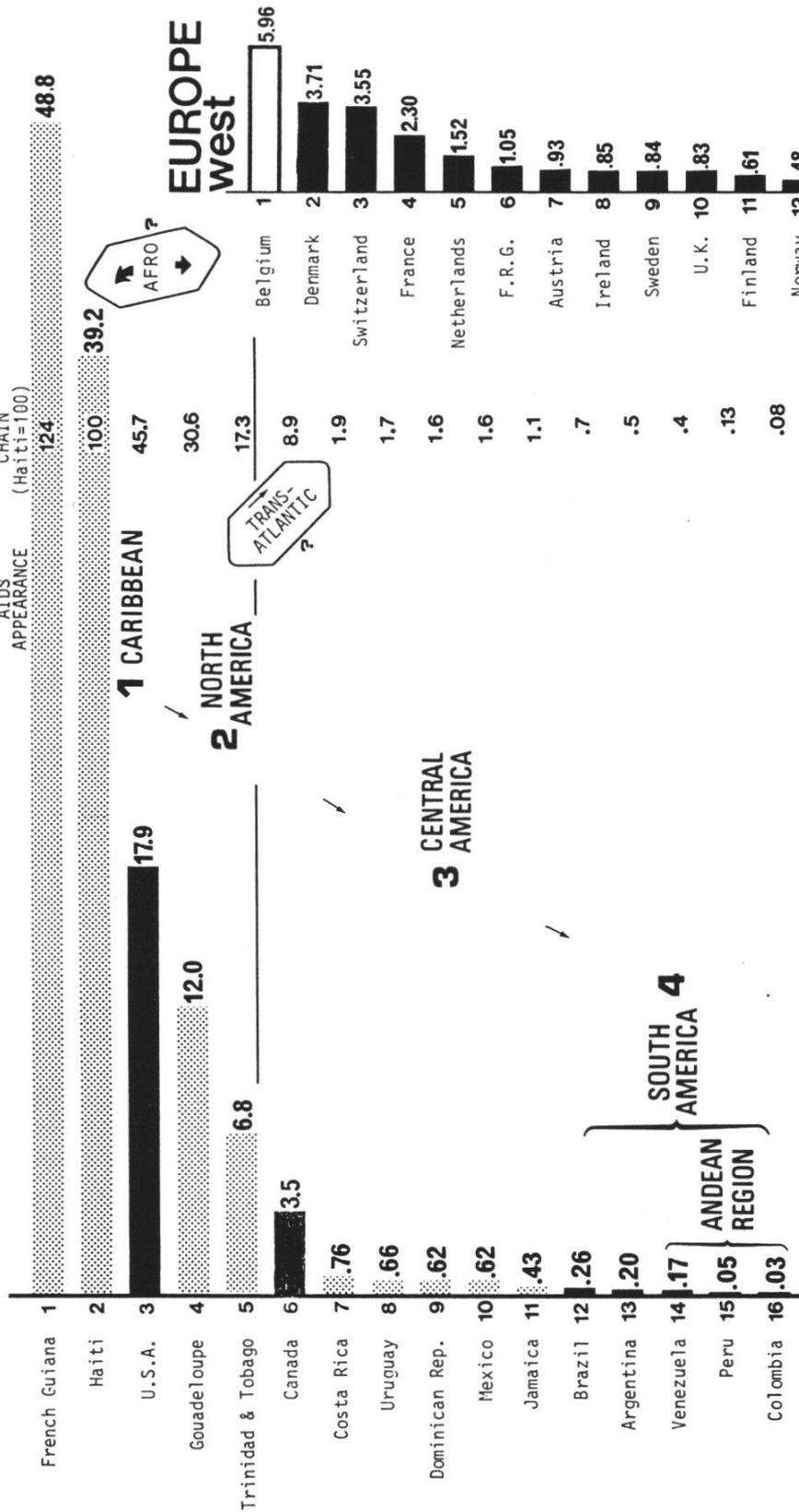
THROUGH-1983 CUMULATIVE AIDS CASE RATES IN THE AMERICAS AND EUROPE(WEST)

RATE PER MILLION MID-1985 (U.N.) POPULATION  
REPORTING STATUS TO WHO/GPA: 1 APRIL 1990

EARLY AIDS APPEARANCE  
IN TWO WHO-REGIONS:  
RELATIONSHIPS?

AMRO  
EURO

THE AMERICAS



INTER-  
WHO-REGIONAL  
L E A P S?

Fig. 3: The end-1983 cumulative AIDS case rates in the Americas and Western Europe.

ANNUAL PERCENT DISTRIBUTION OF REPORTED AIDS CASES BY CONTINENT, 1982 - 1988

1 APRIL 1990 AIDS REPORTING STATUS TO WHO/GPA/SFI

AIDS CASES FOR 7 YEARS: N = 171,150

TREND  
1980s  
3  
AF 03 90

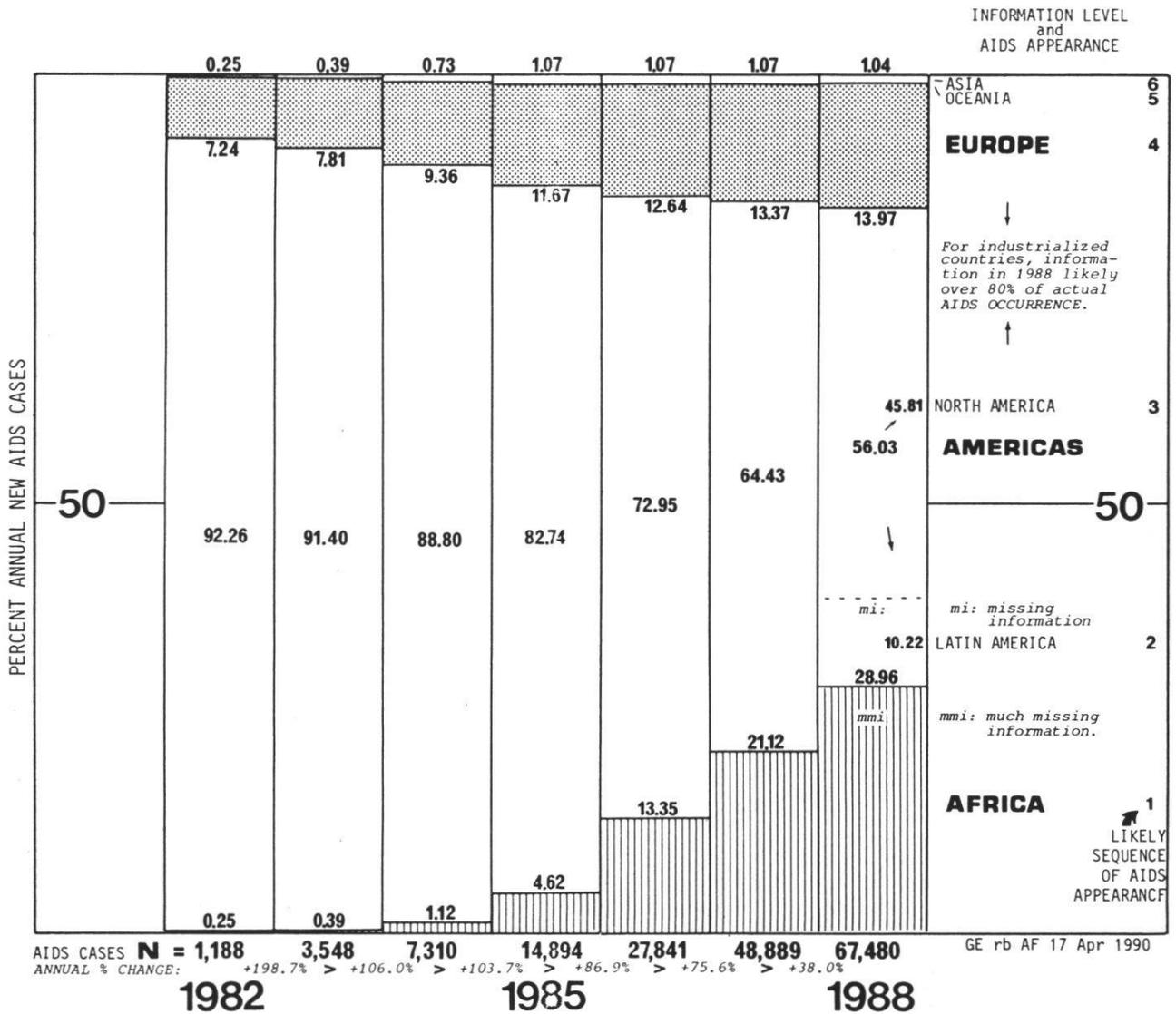


Fig. 4: Annual percent distribution of reported AIDS cases by continent, 1982-1988.

Figures 5 and 6 give early trends of AIDS growth for selected countries in the Americas and Europe during the early 1980's. The semilog plots (rate by time) are informative, since they show both incidence levels and patterns of growth. In the Americas, 4 Caribbean countries attained in the early eighties cumulative incidence rates higher than the USA (although the latter are thought to have a much more complete reporting). Canada's AIDS growth line is quite similar to that of the USA, but «2 years» lower. Canada may have received HIV infected people from both the Caribbean and the USA. Much lower lie other, now Latin American curves, the lowest bundle of curves pertaining to the *southern cone of the Americas*, with Uruguay, Argentina, and Chile, the obvious southern endpoint in a north-south spread of AIDS appearance and hence HIV infection. Note the dramatic steepness of the Brazil curve which expresses strong dynamics of AIDS appearance with a cumulative incidence doubling time much shorter than 1 year. Figure 6 shows a similar display of incidence levels and patterns of growth for Europe. The upper limit of the European curves lies around 2 annual doublings (DT1) below the USA reference curve, with Belgium carrying the highest 1983 cumulative incidence rate. The lower end pertains to *southern Europe* with Spain, Italy, Portugal and Greece. Note Italy's dramatic steepness in AIDS growth which is thought to be an expression of an explosive AIDS appearance in prisons among IV drug abusers. Portugal's steepness needs additional investigation. The valuable data are issued by the Paris Collaborative Center (WHO, 1990b).

Figure 7 shows inter- and intra-state spread of AIDS appearance in Brazil, the only Latin American country with now over 10 000 reported AIDS cases (SNPES, 1990). The «epicenter» is the macroregion called Sudeste (63,3 million population) with the highest 1988 New AIDS case rate of  $4.22/10^5$ . However, additional analyses show that São Paulo state (32 million population) exhibits the highest 1988 new AIDS case rate ( $6.29/10^5$ ) which in turn could be further dichotomized for the city proper (Município São Paulo) and the residual state. The combined cumulative incidence rate through 1988 for São Paulo state is  $12.9/10^5$  (Switzerland:  $12.9/10^5$ !) which sorts out into  $28.1/10^5$  for the city proper and  $5.8/10^5$  for the residual state. The epidemiographic analysis of surveillance information allows thus to show both inter- and intra-state AIDS spread.

Figure 8 builds on São Paulo observations. It displays trajectories of annual percent change of new AIDS cases for some Brazilian data sets, «framed» by the USA and Uruguay. The interest of this mode of presentation is to display/document not only *latest percent change* (top horizontal reading) but also at what secular time trajectories cut across *iso-change lines* of one and two-year doubling times. For instance: The USA «doubled its 1-year to 2-year doubling time» in around 32 months, a reference data set. The two São Paulo trajectories show now clearly an intra-state centrifugal AIDS (hence previous HIV) spread from the city to the residual state. This new display module may contribute to clarifying the current discussions on percent change projections in pattern I-countries (BREGMAN & LANGMUIR, 1990; MORGAN et al., 1990; CDCs, 1990) (see also modules 4 and 12 in AF 03 90).

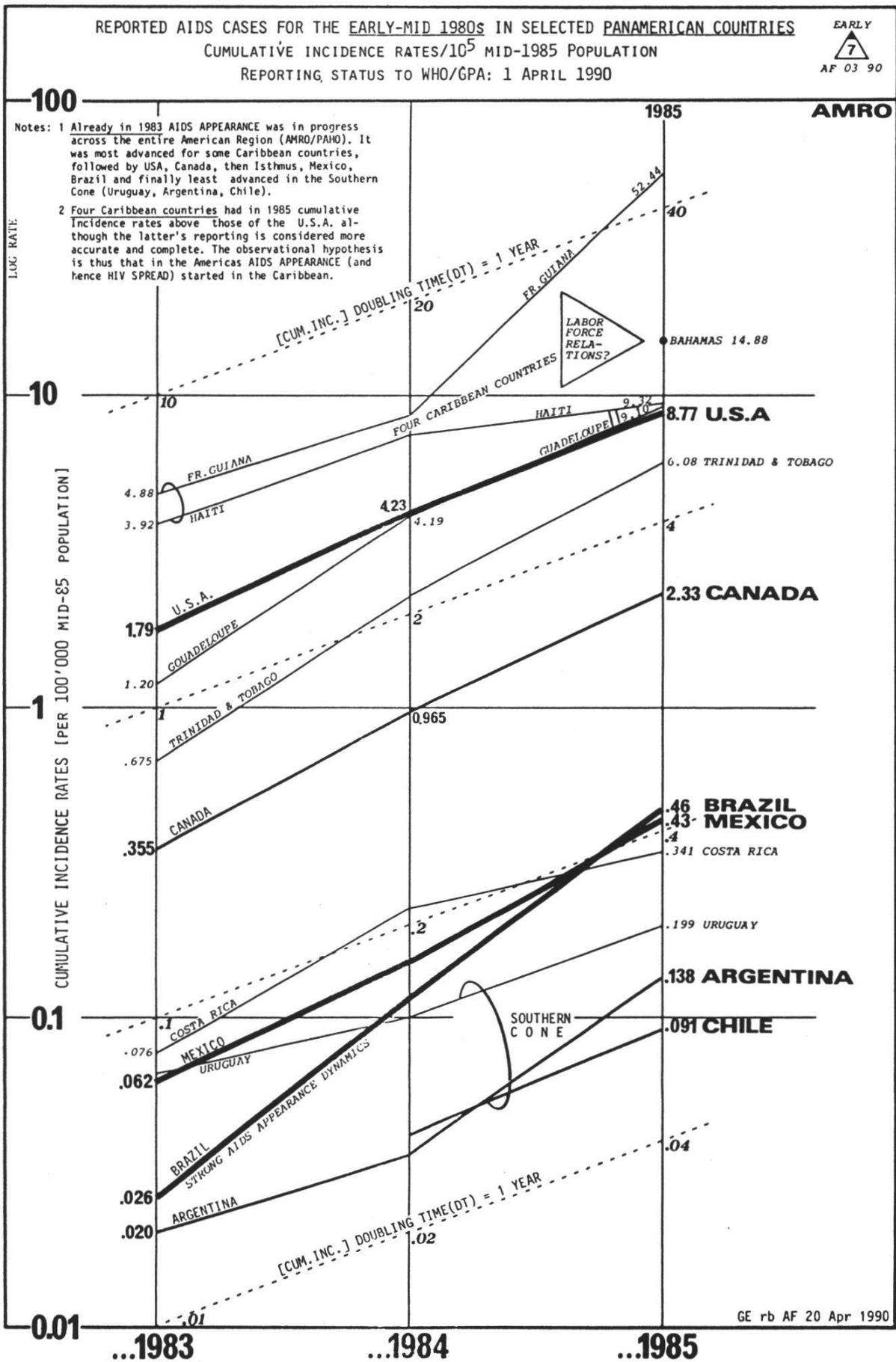
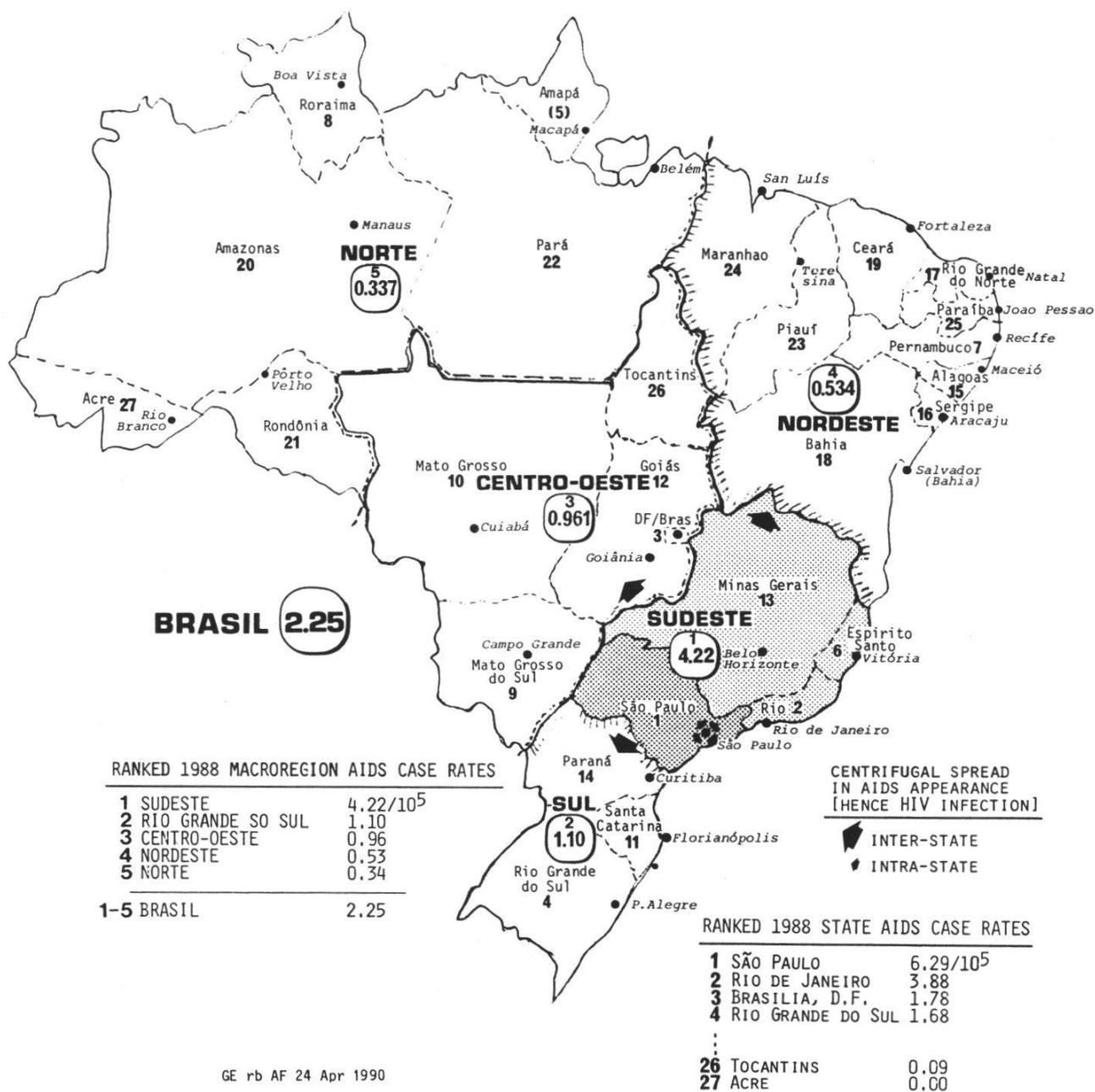


Fig. 5: Early trends of AIDS growth in selected countries of the Americas.



1988 AIDS INCIDENCE IN BRAZIL: 2.25 PER 100,000 MID-1988 POPULATION

1. RATES FOR FIVE MACROREGIONS [4.22 -- 0.34/100,000]  
 2. HIGH-LOW RANKING OF STATES AIDS CASE RATES [1-27] 1-27  
 REPORTING STATUS TO MOH/SNPES (Brasilia) to 3 FEBRUARY 1990 [N=10'058 AIDS CASES]  
 1988 NEW AIDS CASES N = 3247



GE rb AF 24 Apr 1990

Fig. 7: Inter- and intra-state spread of AIDS appearance in Brazil.

# AIDS DYNAMICS IN THE LATE 1980s FOR SELECTED BRAZILIAN DATA SETS, "FRAMED" BY USA & URUGUAY

changes  
BRAZIL

**AIDS CASES: 99'127**    **POPULATION: 304 MILLION**    **AIM: DOCUMENT INTRA-STATE AIDS (HENCE HIV) SPREAD**

ANNUAL PERCENT CHANGE OF NEW AIDS CASES OVER THE PREVIOUS YEAR [(Y/Y-1)] AS AVAILABLE, TO 1988  
REPORTING STATUS TO WHO/GPA: 1 April 1990 [-1988]

AF 03 90

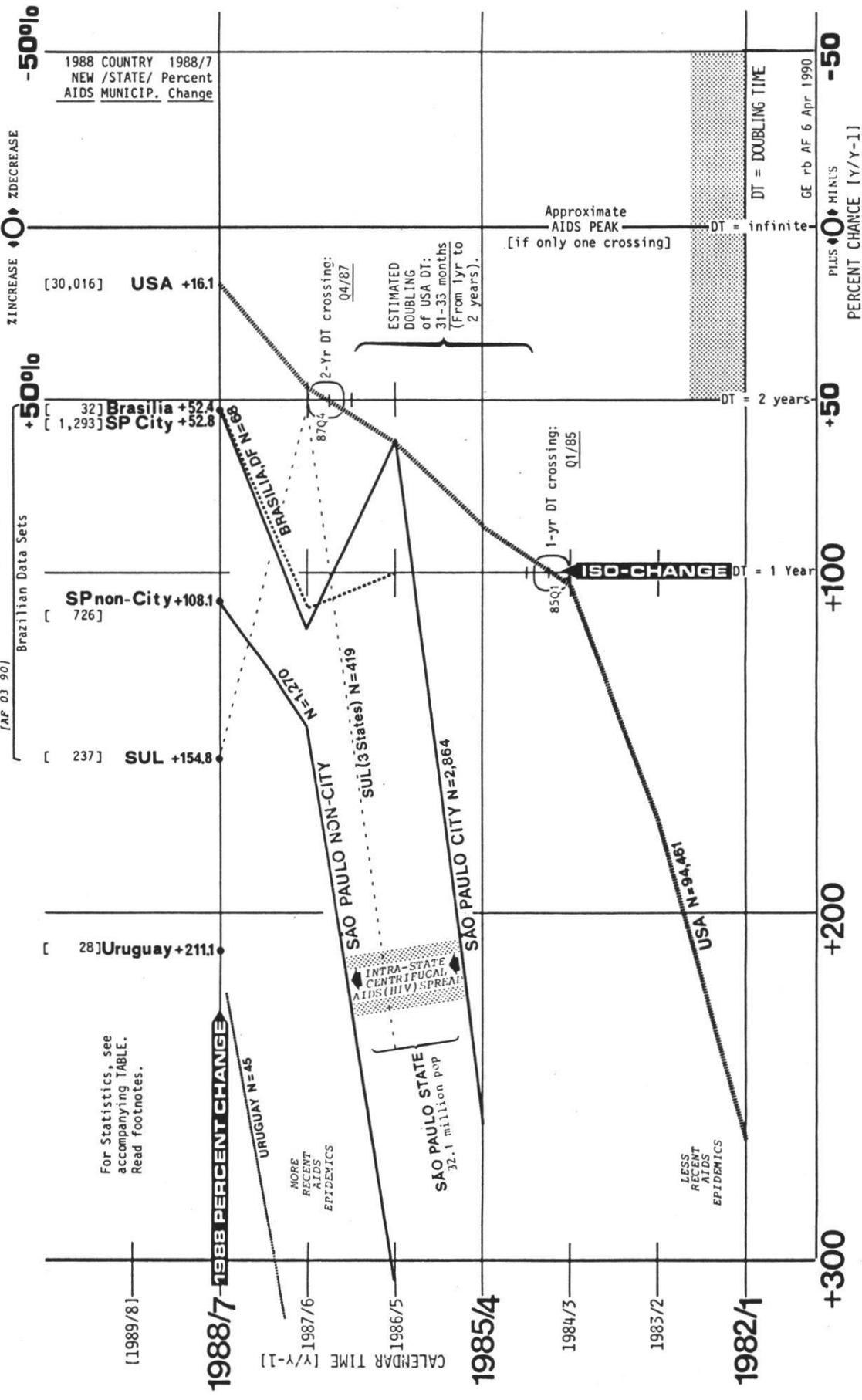


Fig. 8: AIDS dynamics in the late 1980s for selected Brazilian data sets.

## Discussion and outlook

Contrary to initial reservations, the *documented epidemiographic display* of morbidity reports appears to be both productive and projective: productive in the sense of orderly display of patterns and trends in geographic spread of a new disease; projective in the sense of short range extrapolation (Figs. 2,5,6,8). The construct is also inductive. Indeed, despite a 10-year median incubation period, *early morbidity analysis* leads to elements feeding into an overall hypothesis of AIDS appearance and hence HIV infection. According to the current status of analysis and data availability, an early region with AIDS cases, hence HIV infection, was the Caribbean and at least one European country: Belgium (Figs. 3,5). That both may have a common source, is part of this hypothesis. Annual incidence analysis with improved reporting may further clarify this issue. In reviewing the new AIDS cases for 1989 among the three countries that have crossed the 10 000 AIDS case level, one notes for the first time a provocative gradient: Zaire – USA – Brazil. Table 1 shows at a glance this «sequence» of high-low ranking of still provisional 1989 new AIDS case rates. Correction for late and under-reporting on a national level accentuates the gradient, suggesting AIDS to have appeared in Africa several years before the USA, followed some years later by Brazil. Africa (ESSEX & KANKY, 1988) may thus be a common source to the Caribbean and Belgium AIDS experience. One may further hypothesize that the Africa–Caribbean transfer may have occurred at early stages of HIV infection, while the Africa–Belgium transfer was mainly one of early AIDS patients. Subtract 10 years median incubation period to end up in reaching back to the early 1970s or even late 1960s. Perhaps during the 1960s an unusual event occurred that linked the Caribbean with Africa. Apparently, an important technical assistance was given by Haiti to Zaire during the 1960s, subsequent to Zaire's independence. Could it be that some returnees to Haiti carried the HI-Virus that then led to a slow build-up of an HIV pool? An early paper of MOSES & MOSES (1983) may take additional meaning in the context of the current global morbidity flow reconstruction. GRMEK's (1989) painstaking assembly of many publications linked to this topic merits additional review.

In closing, I join in thought Dr. G. DEMIERRE (1987) who stated in an earlier address to this Society that AIDS teaches us to «care again for the next». His colleague from Lausanne PD Dr. J. MARTIN (1988a,b; 1989) carried this thought further in many papers and addresses, as well as in books to reach the current Swiss youth, particularly of the Suisse romande. Finally, the current epidemiography is a growing baseline to assess in the mid-1990's the effects of programmatic efforts in HIV prevention. Switzerland's example setting efforts in the late 1980s should be reflected in curves deflecting towards the mid-1990s even if no treatment were found (KESSEL & BERNARD, 1989).

## Acknowledgements

This is to thank Prof. Dr. med. Sprumont for inviting me to address this Society in February 1989. The updated report is now more comprehensive but has kept to the spirit of my talk. I am also grateful to Dr. J. Chin, of WHO, who has continued to

	Mid-1989 Population (million) <sup>a</sup>	AIDS cases assigned to 1989 (number) <sup>b</sup>	New AIDS Case Rates for 1989 (/10 <sup>5</sup> pop.)	P R E L I M I N A R Y E S T I M A T E S	
				Correction Factor	Rate/ 10 <sup>5</sup> pop
				Number	RATIO
1. Zaire (main hospitals/clinics)	33.500	6,188	18.5	3.50	21,658 64.6 3.3
2. U.S.A. (national reporting, CDCs)	247.500	27,593	11.1	1.75	48,288 19.5 13.3
3. Brazil (national reporting, BEA/MS) <sup>c</sup>	147.250	3,488	2.4	2.50	8,720 5.9 1

a 1989 projected figures from 1988 UN figures cited in 1989 Encycl. Britannica World Data Base, Chicago, USA.

b AIDS Update, WHO/GPA/SFI. 1 April 1990.

c Boletim Epidemiologica, Brasilia, Brasil. Ministério da Saúde, Ano III - N°08, até semana 09/90, term. em 03/03/90.

Tab. 1: Provisional 1989 AIDS incidence rates for the three countries having reported by 1 April 1990 a total of over 10 000 AIDS cases. High-low ranking: Zaire - U.S.A. - Brazil.

provide latest updates and critique of this work. Of course, the responsibility must lie with me. Finally, I am grateful to Prof. E. Kessel, for his continued prodding to «generate additional display modules». One is released for the first time (Fig. 8).

## Summary

This report – originally an address – reviews the reported AIDS cases to the World Health Organization (WHO) as of 1 April 1990 [N=237 110] in place, time and by epidemiologic pattern of spread. The method of «documented illustration» permits to cut across the rich information in eight modules – bricks for an emerging integrative hypothesis on geographic AIDS appearance and hence HIV spread. While descriptive, the approach taken is (a) factual, (b) projective, and (c) inductive. The observational hypothesis is that both the Caribbean and selected countries in Europe have a common source of either HIV transfer (Caribbean?) or AIDS transfer (Belgium, France) originating in Central Africa. A literature search strengthens this «analytical hypothesis». The pattern I-spread (industrialized countries) appears now as a subsequent development of amplification.

## Résumé

### *Les épidémies du SIDA: Documentation graphique de la diffusion*

Ce travail – originalement un exposé – examine toutes les notifications de cas de SIDA à l'Organisation mondiale de la santé (OMS) jusqu'au 1<sup>er</sup> avril 1990 [N=237 110] selon la géographie, le temps et le type épidémiologique de propagation. Une méthode dite «illustration documentée» permet de faire le point en huit modules – des briques pour une hypothèse intégrale sur l'émergence dans l'espace de la maladie du SIDA et par conséquence de l'agent étiologique, le VIH. Bien que descriptive, la méthode d'enquête analytique est aussi (a) factuelle, (b) projective (à court terme), et (c) inductive. L'hypothèse par observation est qu'une source commune en Afrique centrale est à l'origine des premiers cas autant dans les Caraïbes qu'en Europe par transfert soit de gens en incubation précoce (Caraïbes?), soit au début de la maladie (Belgique, France). Une revue de la littérature renforce cette «hypothèse analytique». La diffusion épidémiologique du type I (pays industrialisés) apparaît maintenant comme une évolution postérieure mais à amplification importante.

## Zusammenfassung

### *Die AIDS-Epidemien: Graphische Dokumentation der Ausbreitung*

Diese Arbeit – anfänglich ein Vortrag – untersucht alle der Weltgesundheitsorganisation (WHO) gemeldeten AIDS-Fälle bis zum 1 April 1990 [N=237 110] nach Ort, Zeit und Typus der epidemiologischen Streuung. Eine Methodik der «dokumentierten Illustration» ermöglicht eine Zusammenfassung in acht Modulen – Bausteine für eine

integrale Hypothese des geographischen Auftretens der AIDS-Krankheit und somit auch des HI-Virus. Obwohl deskriptiv, enthält der eingeschlagene Arbeitsweg auch die Elemente (a) Fakten, (b) Projektion (kurzfristig), und (c) Induktion. Die Beobachtungshypothese spricht für eine gemeinsame Quelle in Zentralafrika der ersten Fälle sowohl in der Karibik (Rückreise von Virusträgern?) als auch in Europa (Reise von Erkrankten nach Belgien und Frankreich). Ein nachträgliches Studium der Literatur verleiht dieser «analytischen Hypothese» zusätzliches Gewicht. Die epidemiologische Streuung des Typus I (industrialisierte Länder) erscheint nun als eine nachträgliche Entwicklung mit Amplifikation.

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