Digitising Data on Eurasian Trade Routes: an experimental notation system

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0. Abstract

The paper describes a low-tech and low-cost methodology for collecting data on Eurasian and other trade routes. It records details of their course, users, chronology, movement speeds and other variables. This newly developed methodology, the so called 'OWTRAD' data transcription system, can be applied to a wide range of primary and secondary sources. It can handle raw information in both verbal and graphic formats. It can do so regardless of variations in the sources' reliability and overall precision. It is geared to the creation of large volumes of standardised and correctable digital data sets. Subsequently, these data can be processed, either automatically or by hand, in order to establish their geographical co-ordinates and make them mappable within the context of ECAI's investigations.
I dedicate this work to my best friend and wife, Irena Goltz. May her Canberra garden, in the third millennium, always be filled with birds, butterflies and stars.

1. Introduction

If social and cultural studies are to flourish, it is essential that they take wholehearted advantage of computers and the Internet, and their unprecedented potential to store, retrieve and process vast amounts of data in real-time (Ciolek 1999). The Electronic Cultural Atlas Initiative (ECAI) (www.ecai.org) promises a major shift in the way social science research can be conducted online. However, until suitable digital data become plentiful and readily available, it is doubtful whether the viability of the project can be tested in practice.
This paper explores the possibility of producing plentiful digital data for ECAI projects. It presents a practical methodology for digital collection, storage and publication of information suitable for geo- and chrono-referencing. Naturally, such a methodology, if it is to be adopted by other researchers, needs to be compatible with existing research practice. Therefore, it needs to:

- be quick, easy and inexpensive to establish in a given setting;
- be easy and inexpensive to maintain;
- minimise the need for heavy, tedious or repetitive manual work;
- generate high-quality materials;
- generate materials which are easily correctable;
- generate materials in a cumulative fashion;
- adequately document procedures and the associated know-how;
- foster attempts at online cooperation, yet remain unaffected by any lack of such cooperation;
- be amenable to changes and re-use by other research projects;
  and finally,
- store results in a format and manner which is easy-to-find; easy to copy; easy to distribute, and yet still remains relatively inexpensive;

The proposed methodology hopes prove simple and intuitive enough to become a part of the everyday research toolbox. It hopes to be used by anyone interested in the digitisation of data (through time and space) about communication links between various parts of the world.

2. Available information about trade routes

There is not a great deal of systematic research on trade routes. The field appears to be underdeveloped. It is commonly regarded as a minor adjunct to the wider studies of ancient history, economic history or the anthropology of cross-cultural contacts. For instance, an online search database of the Library of Congress' (lcweb.loc.gov) 12 million records reveals the existence of no more than 65 titles dealing with the topic 'Silk Road' and another 69 titles on 'trade routes' in general. Similarly, the University of California's Melvyl database (library.berkeley.edu) points to the existence of some 206 titles dealing with the Eurasia's 'Silk Road', and 264 titles on other trade thoroughfares in the other parts of the world. These figures are in stark contrast with the equivalent data on other topics. For example, in November 1998, the Library of Congress kept bibliographical details of no less than 3050 books and monographs on the rather esoteric topic of Christian and Buddhist monasticism.
The relative unimportance of the trade routes to the modern cultural studies is further confirmed by data from Table 1.

Table 1
Information about trade routes in five historical atlases

Publication	Maps all	Maps showing data on trade routes
Putzger 1963	105	5
Shepherd 1976	270	9
Scarre 1988	127	34
Stone 1989	430	33
Vidal-Naquet 1992	177	25
Average	221	21

The above figures indicate that less then 10% of all maps published in contemporary historical atlases show the existence and layout of the movement corridors in use for circulation of people, goods and information. However, the relative absence of institutionalised research on these matters is perfectly offset by the almost limitless wealth of raw, unprocessed information.
Practically, there is an inexhaustible amount of intelligence which casts light on the layout and attributes of the trade routes in the Old World. It can be easily found in a wide range of publications and primary sources. Such materials include histories and ethnographies of various countries and regions, as well as memoirs and travelogues of explorers and adventurers.

> For instance, Farooque's work (1977:232-234) indicates that even a very narrow chronological and geographical area such as northern India during the years 1556-1707 was able to attract no less then 32 separate English language books, not to mention French and Portuguese ones, which provide first hand accounts of traveller's adventures and experiences with the road system of the Mughal empire.

Additionally, there are also historical studies describing the disposition and movements of various invading and defending forces. Some of these studies also mention various communication lines employed by government couriers and various postal services. Still another category of materials is formed by publications dealing with the Great Religions of the Old World. They provide useful information about temples, monasteries and other holy places, and the associated pilgrimage routes.
On the whole, materials offered by all these sources form four (see Appendix A below) major groups:

(i) drawings, illustrations and maps which model and annotate details of the terrain across which all these movements took place.
(ii) en passant notes and remarks;
(iii) systematic lists and itineraries of journeys;
(iv) more or less complex 'verbal maps' which attempt to identify various nodal points and the links

between them.

The common aspect of all these publications is the bewildering variety of ways through which the data in question were obtained and documented.
Some of the information pertains to geographic areas some 3000 km wide; while other is more focused and deals with geographical locations no more than few kilometres apart. Some of the data might be based on personal experience, whereas other information can be derived from the second-hand reports or be compiled from a series scholarly investigations such as original archaeological or ethnological field-work. Finally, the available information, even the supposedly rigorously constructed maps and charts, can be of uneven quality (see Table 2).

Table 2
Problems with the maps published in five selected* historical atlases

Shortcoming	Percentage of maps displaying the problem
No time-frame	9%
No legend/key to symbols	12%
Factual errors present	20%
No lat-long grid	53%
No source of information stated	68%
Incomplete annotations of data	69%
No scale is specified	74%
No projection is specified	100%
Total	106 cases (100%)

* atlases analysed: Putzger 1963, Shepherd 1976, Scarre 1988, Stone 1989, Vidal-Naquet 1992
Src: Ciolek (1999).

Therefore, any attempt to bring the masses of colourful but unruly graphic and verbal information under the aegis of an ECAI study is not an easy task. A shortcut which involves digitisation of the existing map material is a tempting but impractical strategy. There is a number of reasons for exercising care:

- Firstly, such an approach threatens to bypass, and eventually ignore, the existence of large volumes of valuable, unmapped but immensely mappable, written information.
- Secondly, the 'direct digitisation' strategy unreasonably assumes the researcher has a ready access to the fairly costly technical equipment such as scanners, digitising tables, and desktop mapping software. Moreover, the researchers may not have the necessary skills in cartography, digital graphics, as well as in effective handling of various devices and programs.
- Thirdly, the approach is 'office-bound'. It requires that the often rare and restricted-access charts and maps be either brought to the premises where the digitisation can be carried out, or that a series of photocopies is made and then brought to the digitising table.
- Fourthly, such procedure always results in inevitable positional errors. Even if one uses maps with the clearly stated lat-long grid and even their projections are correctly inferred, one still produces largely incompatible electronic documents. For instance attempts to 'register' a scanned image of a 1:9 million scale map of major roads in Poland during the 2nd half of the 12th c. (Humnicki and Lalik 1957, see the map in the Appendix A below) on the digital map of Europe, one which was published as a part of the Digital Chart of the World - DCW series (NCSU Libraries 1999), ended up in failure. Such attempts consistently produced 5-20 km discrepancies between positions of the key features of terrain (rivers, coastlines, location of major cities) between the scanned map and the DCW map.

It is obvious then that a different strategy needs to be pursued. Such an alternative strategy is more cautious, and less hasty. It advocates 'deferred digitisation' of collected data and 'deferred marriage' of these materials with the GIS-style base-maps of the world.
Certainly, the raw data need to be captured and stored with equal ease and equal speed, from both textual and graphic source materials. Moreover, such simple data capture must be carried out regardless of the overall integrity and precision of the interrogated materials. Once the required information is extracted it

needs to be put through a series of routine operations. It needs to be collated; brought to a common denominator; verified against the ever-growing body of 'online intelligence' dealing with the major variables; checked for any hidden problems, and, finally, made open to endless and iterative (Raymond 1998, Ditlea 1999) inspection and correction. It is only after all these steps are completed that a data set can be properly geo-referenced and formally incorporated into the framework of other GIS-style, ECAI-compatible data sets.

The crux of this alternative strategy is to embark on an intensive, large scale yet inexpensive data gathering program **before** more costly and more technically demanding, and time consuming data mapping and data plotting programmes are engaged in.
To use a metaphor, before we start constructing a sumptuous palace or a glorious cathedral, it is useful if we first secure a steady supply of solid, modularised building blocks. This is, however, only possible if we learn ourselves how to shape amorphous lumps of clay into the standard-shaped bricks, and also learn how to produce such bricks quickly, inexpensively and, importantly, in large amounts.

3. Trade routes: an archipelago of linked nodes

This section sets out the conceptual underpinnings of a technique for identifying and collecting data on trade routes. In this case it has been illustrated with examples taken from the 'Old World', by which I mean the combined sea and land masses of Europe, Asia and Africa. Most of the presented information tends to be self-evident, nevertheless it is necessary to make the subsequent terminology explicit. The basic notion used throughout this paper is that of 'trade routes' by which I mean spatially and temporarily persistent, land- or water-based long-distance movement corridors. These corridors connect human settlements via a series of other nodal points, and are used by groups of travellers to transport goods in a manner which minimises risks to their personal safety and security and maximises their commercial profits, while keeping the overall travel time as short as possible.
The above definition is handy. It serves as a template for conceptualising other types of routes as well. For instance 'pilgrimage routes' can be viewed as movement corridors, similar to the trade routes, but ones in which goods and the associated commercial profits are not an issue. In similar vein, 'military routes', tend not to concern themselves with matters of profit and personal safety and, instead, place emphasis on transport of people and goods in the manner which is reasonably secure from enemy's intervention and as speedily as possible.
This definition of the trade routes is influenced by the methodological work of the ECAI Silk Road team (Williams 1999), one which discerns *nodes*, *sites*, and *routes*. The present definition introduces three additional notions, those of *links*, *users* and *commodities*. Together they form the following conceptual model.

3.1. Nodes

All over the world, one can discern numerous **nodes**, or places of travellers' departure, transit, temporary stopover and, finally, arrival. Nodes are not pre-defined. Any distinct geographical location, as long as it is frequented by travellers, may serve as a node. There are three categories of nodes: (a) *inhabited places*, such as towns, monasteries and fortresses; (b) various *natural features* (e.g. anchorages, fords, passes, oases); and finally, (c) *man-made constructions* (e.g. reservoirs, harbours, ferries).

> For example, Runciman (1978:215) records that in 1096, near the Levantine city of Antioch, there was a bridge "where the roads from Marash and Aleppo united to cross the river [Orontes]. The bridge was heavily fortified, with two towers flanking its entrance."

Some of the nodes may function as *attractants* because they increase the probability that a place (e.g. a market, bridge, the site of an oracle) will be visited by travellers. By contrast, other nodes (e.g. besieged cities, robber-barons' castles, tax-collectors' outposts), may act as powerful *deterrents* to human traffic. Sometimes the dicision to avoid a given place is based on common sense, sometimes it is quite idiosyncratic.

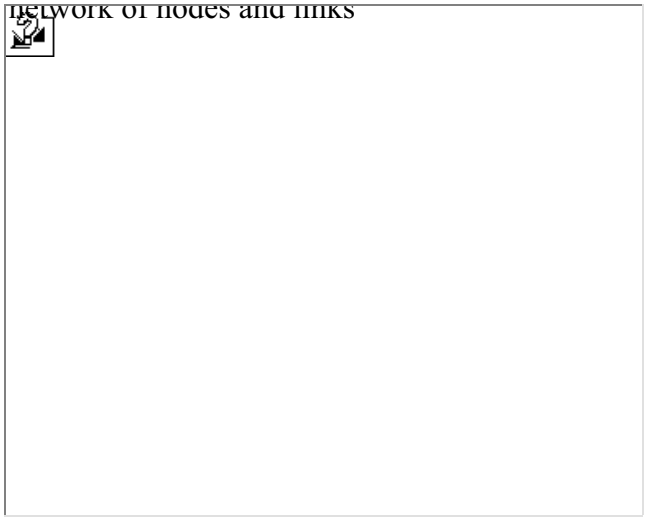
> For example, in 1526 the Mughal Emperor Babur (1483-1530) noted that "The Panjhir road [from Kabul via Anjuman Pass to Feyzabad] [...] is the thoroughfare of Kafir highwaymen who also, being so near, take tax of it." (Newby 1974:94). Newby also writes that a Chinese Buddhist monk "Sung Y [...] crossed the Pamirs to the Oxus in A.D. 519 and entered

> India by way of Kafiristan [Nuristan, NE Afghanistan] to avoid an even more dreadful crossing of the upper Indus by a bridge constructed from a single iron chain" (1974:88).

The nodes, of course, differ from each other in terms of their physical size and social and cultural characteristics. All of them are mappable as long as they have been assigned precise chronological and geographical coordinates, calculated from a map, or taken from the growing body of specialist registers and online databases (see also Appendix B below). Some nodes may double as **sites** (locations where artefacts and archaeological finds have been uncovered) (Williams 1999:585), whereas other nodes may not have any artefacts associated with them.
In terms of mapping, certain kinds of nodes such as inns or road junctions, can be characterised as points on a map. Other nodes, e.g. oases or towns, might be visualised as roundish areas enclosed by a perimeter (a wall, an irrigation ditch). These most typically have one or more central points (a temple, a forum, a well). Finally, some nodes, such as a portage area, can be best depicted as a strip with an invisible spine of minor topographical sub-nodes.
Some nodes may have unique names, since they are perceived as places, that is, distinct locations endowed with social and cultural characteristics. Other nodes, like anchorages and watering holes, may remain nameless. They have a physical existence but they are commonplace or ill-defined, and so have not established a separate social existence. Such nodes usually derive their identity from features of the nearby landscape, as well as from the role they play within topology of a particular communication/transportation network.
The spacing between nodes varies widely. It is always a function of the researcher's decision of what pair of geographical locations will serve as nodes, say, 'A' and 'B'.

3.2. Links

Often the space between two particular nodes remains unexplored and untraversed by people for long periods of time. Of course, in reality there is no such thing as a totally uncrossable stretch of space. As the WW2 memoirs of Rawicz (1997) and Harrer (1955) testify, determined individuals are able to suffer the most terrible privations for several years on end and walk through the most inhospitable types of terrain. On the other hand, such space may become a communication **link** when it is spanned by customary traffic.
A link is thus a stretch of space commonly used for movement between a pair of nodes. If these nodes are called 'A' and 'B' then such a link can handily be recorded the 'A=B' link. This means that our definition of a link applies not to all possible connections between pairs of nodes, but only to those which are the most prevalent.
Links can vary greatly in length. Sometimes a link is very short. For instance, distances separating two adjacent spots in a city (e.g. the warehouse and the pier) would measure only in the tens of meters. Or, it can be immense, and measured in the thousands of kilometres, like the distance between the Bosphorus and the Gibraltar Strait, at the opposite ends of the Mediterranean.
All links (apart from river and coastal links), by definition, are represented by a straight line. This is because links refer to the generalised, logical connectivity between two nodes, and not to the actual analog trajectory traced across the terrain by the travelling parties. Naturally, for short distances, a straight line is a fairly accurate representation of the real-life path taken by the travellers. In the case of longer distances, the trajectory meanders. However, if we do not have information on intermediate nodes, we must *postulate* that, on land and open sea, such a long-distance link is a straight line. This assumption is, of course, an expedient but temporary simplification. It needs to be replaced, eventually, with information on the intermediate nodes (as well as associated links). Finally, in the case of coastal and river communication links the mapped line can be assumed to follow fairly faithfully the contour of the shore or the river in question.



A network of transport/communication links in an imaginary landscape [GIF 5KB]

Legend:

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Solid circles   inhabited nodes
Empty circles   uninhabited nodes
Solid lines     land communication links
Dotted lines    sea communication links
A=D             coastal sea link
P=Q             open sea link across Alpha Sea
A=G             land link connecting nodes A and G
H=I=J=K=Q=P=L=
 =B=F=C         land and sea route across country Gamma (nodes H,I,J),
                Alpha Sea (node Q), and country Beta (nodes P,L,B,F and C)
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3.3. Routes

In other words, large scale distances between a pair of nodes can be defined as a **route**, that is an unique series of interconnected links, say, 'A=G=E=B=L=P' each of them represented by a straight line between adjacent nodes: 'A=G'; 'G=E'; 'E=B'; 'B=L' and finally, 'L=P' (see the hypothetical map above). This is, of course, different, from the one spanning the distance 'A=G=E=O=M=N=F=C'. The two routes share, of course, the common stretch between nodes 'A' and 'E', and then they go their separate ways.
Routes, by definition, tend to circumnavigate *obstacles* (e.g. marshes, forests, waterless wastelands, mountains, steep cliffs, fast flowing rivers, rapids). They seek to establish the least physically demanding transit, one which is traversable in all weather conditions, if possible. They also aim to be the safest and logistically most advantageous passage between pairs of attracting nodes.
Most routes are chosen so that they take advantage of the natural configuration of terrain (e.g. valleys, sheltered coastal waters, mountain passes).

> For example, commercial water routes were in operation as far back as the end of the 3rd millennium BCE (Grohmann 1933:101-4).

Other routes (and therefore, links) can be established by artificial means: the levelled or paved roads, tunnels, causeways and canals are the most commonly encountered structures.

> For example, "the road over the Mablaqah pass [in Yemen, 6th c. BCE] from the kingdom of Qataban was paved for five kilometres, with a small reservoir for camels and travellers at each end" (Scarre 1988:184). Also, Sweeten (1999) provides a first hand account of the Chinese road that crossed into Guangdong at the Meiling Pass. He writes: "I was lucky and south of Dayu found that part of the old 'Imperial Highway' has been preserved. [...] The pathway is of cobblestone and varies in width from ten to fifteen feet and continues into Guangdong."

The physical width of links/routes can also vary. Sometimes, like some of the North Saharan tracks (Lewis 1997:133), they can be ten to twenty kilometres wide. Sometimes, like in the case of the ancient passage through the Cilician Gates (Golek-Boghaz) in the Taurus Mountains in Asia Minor, they can be so narrow that burden animals need to be unloaded (Fuller 1958:97), in order that they squeeze through the narrow defiles.

Generally speaking, there are four basic types of links:

(a) land links, where the most of the traffic and transportation involves people, animals and vehicles;
(b) river links, where the transport involves river craft plying a body of water;
(c) coastal links, where boats and ships move from one nodal point (i.e. harbour, bay, shore settlement) to another by navigating roughly along the protective edges of the coastline;
and finally,
(d) sea links, or maritime lanes, where boats and ships navigate between points or departure and arrival without seeking an overnight shelter/rest at the shore. The above distinction applies to routes (i.e. combination of adjacent links) as well.

Naturally, there may be more than one link bringing together two adjacent nodes. For instance, there may be one major road, as well as a series of locally known trails, shortcuts and paths. As military history illustrates, the outcome of many battles, including those of the Thermopylae in 480 BCE and the Persian Gates in 330 BCE, was decided when one of the warring sides exploited a minor and generally unknown trail (Fuller 1958:228-233, Fuller 1970:55-56).
As we have already noted, a series of links strung together forms a route. Routes can have various topologies, ranging from simple chains and loops, to stars, forks, and lattices. The overall topology is, of course, very much a function of the scale of one's sampling procedure. The larger area of study, the more complex the system of routes it contains tends to be.

3.4. Users

Links and routes are created by the presence of people moving from one node to another. Such traffic of **users** (i.e. people, animals, and vehicles) pulsates and alternates between the routes in response to the changes in weather, time of the year, local conditions (such as famine, plague, unrest) and overall economic and political circumstances. Various individuals and groups of travellers, such as soldiers (Adams 1976), bandits, raiders, messengers and couriers, pilgrims, mendicants, merchants (Casson 1984, Curtin 1984), refugees, migrants, local tradesmen, businessmen, explorers (Newby 1974) and so forth, can move along a given route in a simple sequential fashion (i.e. one group of people after another), or in parallel with each other, or move unpredictably across the Gordian knot of links.
The users of nodes and routes display a number of attributes. These include the social, demographic and ethnic characteristics of the people traversing a given route as well as the technological, economic and logistical aspects of their activities.
Of the logistical variables, questions of the demand and supply of food, fodder, water, fuel, spare parts, and noncomestibles; the ratio of humans to animals; the movement speeds and the overall endurance; as well as the optimal and maximum carrying capacity of humans, animals and vehicles - all are of key importance.

> For example, it has been observed that a dromedary camel "can go 5-7 days with little or no food and water" (ArabNet 1996), while the bactrian camels can go "without watering for 7-8 days, even under the sun, and may lose [without dying] as much as 221 lbs. of water which is about 22-25% of their body weight" (Cheng 1984). Also, it is noted that in the 13th. century CE, in the Persian Gulf "the dhows that sailed the Indian Ocean carried 100-400 tons [90-360 metric tons] of cargo. A large one could carry up to seventy war horses and a hundred fighting men along with other crew and passengers" (Curtin 1984:120).

All these variables are closely interrelated and can be represented in the form of an arithmetic formula (Engels 1978). The formula balances daily food and water requirements of people, as well as those of the accompanying animals (saddle and pack) against their physical capacities to carry weights (such as supplies, trade goods, weapons, tents etc.) over extended distances. The formula shows that in the case of overland journeys, one which would involve horses, mules, oxen, donkeys (but not, apparently, bactrian camels or dromedaries), it is not possible for a body of men and animals, regardless how many of them would travel together, to proceed for "more than four days without replenishing its water in a terrain where no water or grain was obtainable" (Engels 1978:63).
Other factors also play a role. These include the ability of travellers to orient themselves and operate in the unfamiliar terrain (Lewis 1997); their ability to move surely and systematically (despite frequent adversities of weather, and presence of natural obstacles) from one node to another, and to negotiate (often without the knowledge of the local language) and secure vital supplies, accommodation, health-care, reliable guidance

across a given territory, and essential politico-economical briefs about the developments on next leg of the journey.

3.5. Commodities

The final variable important to the studies of trade routes is that of **commodities**, the transport of and trade in which comprises the raison d'etre for countless nodes and links. These goods are evidently most diverse, and their exact nature, monetary and symbolic value, volumes traded, as well as impact on the suppliers, distributors and buyers change from one geographical area to another, and also according to the historical period.

> For example, during the Augustian empire (44BCE-70CE), Alexandria "provided Rome annually with 5,000,000 bushels [of wheat], ca. 135,000 tons, an enormous amount that filled fully one-third of the city needs." (Casson 1984:81). A millennium and half later Alexandria supplied Venice with "2,500,000 pounds of spices [ca. 1,125 tons]... every winter." (Lane 1934:26 cited in Casson 1984:93)

In a nutshell, the traded commodities included weapons; luxury goods (e.g. gems, precious metals, ivory, arts &craft, perfumes, incense, manuscripts and books); raw and semi-processed materials (e.g. ingots of metal, timber, tar, wax); salt, spices and medicines; foodstuffs (e.g. grain, oil, wine, vinegar, fruit) textiles, tapestries and furs; pottery and glass; animals (e.g. homing pigeons, horses, beasts of burden, circus animals); slaves; as well as a great variety of contraband, including the by now legendary silkworm.
The circulation of goods gave rise to numerous evocative names such as 'Amber-'; 'Gold-'; 'Spice-'; 'Slave-'; 'Incense-' and 'Silk-routes.'

4. The OWTRAD notation system - an overview

A tool which can possibly be used to exploit both graphic and verbal information and produce large amounts of digital data relevant to ECAI purposes is a simple **notation**. Such a notation, or transcription system aims to summarise any extracted data in a standard, predictable and unambiguously legible format and store them as universally legible electronic ASCII files so than any future corrections, enhancements and refinements can readily take place.
Since the experimental notation system described below was initially developed to handle data about the trade routes of the Old World (i.e. Asia, Africa and Europe), it will be henceforth referred to as the 'OWTRAD' notation. The objectives of the OWTRAD notation are two-fold. Firstly, the notation aims at extraction of standardised chunks of information from a large variety of sources. It does so by creating a predictable sequence of conceptual pigeon-holes which can be easily filled with details for each pair of communication links. If a given item of information is not available, then the notation uses the standard default value. Secondly, the notation aims at being a simple and versatile tool, one which can be used manually, or as a part of ones' use of a typewriter or computer keyboard.

4.1. Basic requirements and elements of the proposed notation

Data sets produced with the aid of the OWTRAD notation system do not aim, in the first instance, to provide detailed geo- and chrono-referenced information. They aim to create a body of information which can be subsequently easily referenced according to the specifications of the ECAI project. They aim at the production of information in a format which enables it to be soaked up, if necessary, by various data-bases and subjected to additional refinements and post-processing.

- The notation should provide a standard place-holder for the following information:
  - Identity (and hence unique geographical coordinates) of nodes connected by a communication/transport link;
  - Some basic details of the link in question;
  - Full details of the source from which this information has been extracted;
  - Indication of the completeness of the source as well as amount of detail (granularity) offered by it;
- The proposed notation system can be rigorous and detailed, but it needs to be intuitive. The employed labels and abbreviations have to be short, consistent and as much as possible mnemonic.

- The proposed notation should use sturdy and inexpensive technology. It should be versatile enough to be used as hand-written notes, on a typewriter or a computer. This means that it should restrict itself to only a plain text, low ASCII set of characters.
- Transcription of the data should be a speedy and pleasant task. It needs to be carried out in a series of simple, uncomplicated, almost mechanical steps.
- The transcription needs to cope well with any interruptions and distractions. It should perform well in a variety of research environments: home, office, library, even brief forays into bookshops. The transcription should be able to deliver even a fragmentary, incomplete data-set.
- The collected information needs to always be traceable to and comparable with the source from which it has been derived.
- The collected information needs to be amenable to endless corrections and refinements.

4.2. The OWTRAD notation system - basic elements

The OWTRAD notation, in its current (Jan 2000) version succinctly represents data about some 14 key variables. These are:

(1) departure node, its type, name and general geographical provenance;
(2) arrival node, its type, name and provenance;
(3) general physical environment;
(4) route details;
(5) user details;
(6) uses of the communication link;
(7) type of the communication link;
(8) relative importance of the communication link;
(9) physical length of the link;
(10) time required to travel the distance;
(11) chronological context;
(12) source quality and data quality;
(13) bibliographical reference; and finally,
(14) data set identifier.

In other words, the notation handles information about nodes, links, routes, and users. It does not deal, at this stage, with variables pertaining to the transported commodities.
For instance, a brief (in this instance 17 words) expression referring to one of the lines on a map entitled "The economic life of the Roman Empire" (Stone 1989:91) which is a part of the "'Times' Atlas of World History":
Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
identifies and describes

> "a maritime communication link between two named locations: Panormus and Ostia, in Sicily and mainland Italy respectively. This link was a part of some unspecified larger network. This link was used by Romans as a major trade avenue. Neither its overall length, nor time needed for the travel between the two geographical locations is stated. The link was in use in the 2nd century CE. The source from which the above notes are derived is of low quality: it does not state its own sources of information and it refers to geographic area more than 1000 km across. The entire packet of information belongs to a data set which deals with the 2nd c. CE sea lanes of the Mediterranean Sea."

The elements of the propoposed notation are introduced, step by step, below. Each vasic elemenent of notation is highlighted in **bold** letters and briefly annotated:

1. departure node, its type, name and general geographical provenance (e.g. named or unnamed place in a given country)
   e.g.
   Expression: **Panormus@IT (Is.Sicily) =** Ostia@IT [S frame:unspec romans trd av maj d000dd t000t m0200y QC3

(Stone 1989:90-91) XMEm0200]
Value: there is/was a communication link "=" starting at "Panormus". The departure node is situated in the present day Italy, more specifically, on the Island of Sicily.

2. arrival node, its type, name and provenance
   e.g.
   Expression: Panormus@IT(Is.Sicily) **= Ostia@IT** [S frame:unspec romans trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: there is/was a communication link "=" terminating at "Ostia". The arrival node is situated in the present day Italy.
3. general physical environment (e.g. open sea route, land route, river route)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [**S** frame:unspec romans trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: an open sea route.
4. general context, the communicational network, the frame which the given link is a part of.
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S **frame:unspec** romans trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: details of the frame are not stated in the source.
5. user details (e.g. Greeks, Romans etc)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec **romans** trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: used by inhabitants of the Roman empire.
6. uses of the communication link (e.g. trade route, pilgrimage route)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans **trd** av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: used for the trade purposes.
7. type of the communication link (e.g. general communication line, actual road)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd **av** maj d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: an unimproved movement corridor, i.e., an avenue.
8. relative importance of the communication link (e.g. minor road, major route, etc.)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av **maj** d000dd t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: apparently, a major route.
9. physical length of the link (e.g. miles or kilometres)
   e.g.
   Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj **d000dd** t000t m0200y QC3 (Stone 1989:90-91) XMEm0200]
   Value: the length of the route between Panormus and Ostia is not stated by the source.
10. time required to travel the distance, as stated by the source
    e.g.
    Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd **t000t** m0200y QC3 (Stone 1989:90-91) XMEm0200]
    Value: the travel time on the route between Panormus and Ostia is not stated by the source.
11. chronological context
    e.g.
    Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd t000t **m0200y** QC3 (Stone 1989:90-91) XMEm0200]
    Value: the route was in use in the 2nd century CE.
12. source quality and data quality
    e.g.
    Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd t000t m0200y **QC3** (Stone

1989:90-91) XMEm0200]
Value: the source is rated to be of relatively low, "C" quality, the data are to be of relatively low, "3" quality.

13. bibliographical reference
    e.g.
    Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd t000t m0200y QC3 **(Stone 1989:90-91)** XMEm0200]
    Value: information comes from pages 90-91 of a book by Stone, Norman (ed.). 1989. "The Times" Atlas of World History. Third edition. London: Times Books Ltd.
14. data set identifier
    e.g.
    Expression: Panormus@IT(Is.Sicily) = Ostia@IT [S frame:unspec romans trd av maj d000dd t000t m0200y QC3 (Stone 1989:90-91) **XMEm0200**]
    Value: the data set is called "XMEm0200", to indicate that it deals with the "X", ie. sea routes; criss-crossing the "ME", Mediterranean Sea, mainly in "m0200y", i.e. the years of the 2nd century CE.

5. The OWTRAD notation system - format

The following terminology intends to capture information originally expressed in verbal as well as graphic formats (remarks, descriptions, maps, plans, situational charts - see Appendix A) and convert it into a simple, regular written format.

5.1. & 5.2. Departure/Arrival Nodes

Place identifiers

Meaning: a node, place or other reference point in the terrain which identifies a beginning and end of a given stretch of road or other communication link.
Example: ArabiaEudaemon@YE : a place in contemporary Yemen, referred to by the source as 'Arabia Eudaemon'.
No of characters used: several chars.
Further details:

- NNNNN - an inhabited place
- frk, xrd, qrd - (unnamed road junction. It may take a form of a fork [a point where 3 road branches meet together], crossroads [4 branches]); or of the quintuple crossroads (qrd, for short) [5 branches] - a unnamed node, may be (or not) an inhabited place;
- ?? - not known location
- XX - country identifier, following the ISO 3166 country codes terminology (RIPE 1997);
- ??NNNNN@XX - possibly a place NNNNN in a country XX
- ??000@XX - an un-identified place no. 000 in a country XX (e.g. '??001CZ' means an unidentified place in contemporary Czech Republic);
- R.NNNNN001@XX - an unnamed NNNNN river-crossing no. 001 in country XX
- frk001@XX (NE Milcz, NW, WS Wroclaw) - a description of a road junction in a country XX According to the annotations, a node called Milcz is NE of the point in question, Wroclaw is S, the other two roads are NW and WS of it, respectively);

Annotations

Directional and locational annotations are enclosed in **()** round brackets.

Geographical descriptors
- Arch. - archipelago
- B. - bay
- Is. - island, islands
- L. - lake
- O. - oasis

- R. - river;
- Str. - strait
- XBL - Baltic Sea (note, a marker 'X' denotes a sea or an ocean)
- XME - Mediterranean Sea

Additional comments

- along - follows the course of the terrain (shoreline, valley, river etc);
- at R.NNN - a point or a settlement situated on a river NNN
- R.NNN/YYY Sea - a point or a settlement situated on a spot where river NNN enters the YYY Sea.
- at mod NNNN@XX - in the location of the modern settlement NNNN in country XX;
- below - downstream from the reference point
- close to - road segment travels in vicinity of, but without entering a given inhabited place;
- confl. - confluence of two rivers;
- l.bank - left bank of river;
- mod - modern, contemporary;
- near - in general vicinity of;
- numerous stages - details of the travel route are currently unknown;
- portage - a land segment between routes which follow a course of rivers;
- r.bank - right bank of river;
- other annotations to be added here as necessary...

Note: All other variables, starting with "General environment" and finishing with "Data set identifier", are enclosed in **[]** square brackets.

5.3. General environment

Meaning: Overall information on the type of the communication link.
Example: "R", a route which follows the course of a river.
No of characters used: 1 char.
The range of values:

- C - coastal sea route (following the course of the shoreline, or across a strait)
- L - land road/route
- R - river route (following the course of a river or estuary)
- S - open sea route
- other values to be added here as necessary...

5.4. Frame (geographical context of the communication network)

Meaning: Role of the communication link within the context of other links
Example: "frame:Constantinople-BalticSea", a communication link which is a part of a route spanning the two reference points.
No of characters used: several chars.
The range of values:

- frame:unspec - default value
- frame:Brno-Krakow (Note: frame descriptors, where possible, are listed in south-north, and west-east order)

5.5. Users' details

Meaning: Ethnicity of the most common users of a given set of links.
Example: viking : Vikings.
No of characters used: 6 chars.
The range of values:

- carolg - Carolingians
- hellen - Hellens (Greeks)
- indian - Indians
- romans - Romans
- viking - Vikings
- unspec - User type is not specified
- other values to be added here as necessary...

5.6. Usage details

Meaning: The primary function of the link in question.
Example: plg : a route used by pilgrims.
No of characters used: 3 chars.
The range of values:

- mil - military
- msg - messenger, post
- plg - pilgrimage
- rob - raid, robbery
- trd - trade
- xpl - journey exploration
- nsp - not specified
- other values to be added here as necessary...

5.7. Type of the link

Meaning: Distinction between natural and artificial structures.
Example: rd : a beaten path, a road, a highway.
No of characters used: 2 chars.
The range of values:

- av - avenue, a naturally occurring configuration of terrain suitable as a movement corridor, e.g. see and river lanes, or ibex trails in the Hindukush Mountains, as in Newby 1974, photograph 5, printed between pages 128-129.)
- rd - road, an artificially occurring configuration of terrain suitable as a movement corridor (i.e. an intentional, physical structure)

5.8. Importance of the link

Meaning: Importance of the link, as recorded by the source for the particular time-frame.
Example: loc : local communication link
No of characters used: 3 chars.
The range of values:

- maj - major
- med - secondary
- min - minor
- loc - of local significance only
- nkn - importance of the road/route is not known (default missing value)

5.9. Length of the link

Meaning: Information of the physical characteristics of the link.
Example: r017km : 17 kilometres, real measurement.

No of characters used: 1+3+2 chars.
The range of values:

- type of measurements (1 char)
  - s - the shortest possible distance (crow's flight), computed as a straight line between points A & B; or in case of the intervening obstacles computed as a sum of the smallest possible number of straight lines circumnavigating the obstacle in question.
  - r - real measurement in the field, or computed from a map. See, for instance, Engels' methodology (1978:28).
- 000 - actual value (rounded up/down to the nearest integer value) (3 chars)
- units of measurements (2 chars)
  - ft - feet
  - yd - yards
  - mt - meters
  - km - kilometres
  - ml - miles
- d000dd - default missing value

5.10. Travel Time

Meaning: Time needed to travel a given stretch of distance.
Example: e008d : estimated measurement, 8 days.
No of characters used: 1+3+1 chars.
The range of values:

- type of measurements (1 char)
  - p - precise measurement, as stated by the source
  - a - approximate, as stated by the source
  - e - estimated measurement (from known distances and mode of travel)
- 000 - actual value (where possible recalculated as days, rounded upwards e.g. 2.5 weeks : 14+3.5 = 18 days; 1.5 months = 30+15 = 45 days) (3 chars)
- units of measurements (1 char)
  - h - hours
  - d - days
- t000t - default missing values

5.11. Chronological context

Meaning: Time when a given link was in use.
Example: m1410y : in 1410 CE.
No of characters used: 1+4+1 chars.
The range of values:

- historical period (1 char)
  - a - 'ancient' (BCE)
  - m - 'modern' (CE)
- NNNN - a four digit date, qualified by the historical period; e.g. 'a1730' stands for 1730 BCE; 'm1730' stands for 1730 CE.
- measurement qualifier (1 char)
  - y - year, exact date; e.g. 'm1250y' stands for 1250 CE.
  - c - circa, approximate date; e.g. 'm1250c' stands for circa 1250 CE.
  - s - the decade or century of; e.g. 'a1000s' stands for the 1st c. BCE and the 'm1410s' stands for the period 1400-1410 CE.

5.12. Data Quality Tag

Meaning: Overall trustworthiness of the information in the opinion of the collator, a way to rank credibility and precision of various sources. Better data and better sources suggest that a given set of variables should be taken more seriously than one which is a less trustworthy.
Example: QA1 : information comes from a publication which gives ample (A) detail of its methodology and its own sources; the reported data pertain to a terrain which is under 100 kms across.
No of characters used: 3 chars.
The range of values:
Letter Q ('q' for 'quality'), followed by a 2 digit alphanumeric code
Sources vary in terms of the amount of detail they provide about their data (see Table 3).

Table 3
Four levels of generality in publications

Level of generality	Range of information	Type of publication
1st	data + source + context + methodology	research papers, journal articles
2nd	data + source + context	monographs
3rd	data + source	overviews, text books
4th	data	syntheses, maps, encyclopaedias [also, newspapers & propaganda]

For further discussion of issues of information quality and reliability

see Ciolek 1999.

Hence the following scheme:

- A - Ample information: sources report data, their bibliographical details as well those of the context to which they apply (generality levels 1 & 2).
- B - Average information: sources report data and their bibliographical details (generality level 3).
- C - Inadequate information: sources report only data but no other background information (generality level 4).

At the same time, data vary in terms of the amount of detail their offer, that is, in terms of their granularity. Hence the following scheme:

- 1 - Fairly detailed data: the geographic scope of the study covers distances under 100 km
- 2 - Medium detailed data: the geographic scope of the study covers distances under 1000 km
- 3 - Inadequately detailed data: the geographic scope of the study covers distances under 10,000 km

These six values, if intersected, create a nine-fold matrix

QA1	QA2	QA3
QB1	QB2	QB3
QC1	QC2	QC3

In the above matrix **lower values** (i.e. A & 1), both for sources and their data, signal information's **better quality**.

5.13. Source of data

Meaning: The publication from which information has been extracted. A short reference to the author's name, date and page of publication is given in round brackets. The reference pertains to the bibliography associated with a given data set. This bibliography is stated in the set's meta-data section.
Example: (Runciman 1978:184)
No of characters used: several chars.
Further details: all bibliographical details are provided in the meta-data section of the data-set

5.14. Data set identifier

Meaning: The name of the data set is the name of its file in a particular subdirectory.
Example: XMEm0200
No of characters used: several chars.
Further details:

- general geographical region to which data pertain (a letter X denotes information about large bodies of water, i.e. seas and oceans)
- details of its chronology are given in line with the OWTRAD convention.

6. The notation system in action

Armed with the above tool we can proceed to a practical demonstration of the way OWTRAD notation system extracts information from the available sources.
As an example I shall process information provided in a paper describing the road network in the vicinity of a prehistoric settlement of 'En Haseva in Israel. The material quoted below names 13 reference points and postulates the occurrence of a number of movement routes in an area measuring some 250 km in length and 100 km across.

> "The small Stratum 4 shrine and its assemblage of clay and stone cult vessels establishes 'En Haseva [in Negev desert, Israel] as a cult site along one of the Arabian trade routes apparently already in existence [...] The site may be connected to pastoral nomads or caravaneers who were active on the southern fringes of Judea [...]
> As in the periods preceding and following, 'En Haseva of the seventh-sixth centuries BCE stood at an important junction with trade and communication arteries leading northwest, south, east, and west. The northwestern route led to Beersheva by way of Horvat 'Uza, Horvat Qitmit, Tel Malhata, Tel 'Ira, and Tel Masos. Alternatively, from Horvat 'Uza one could travel to Arad, Horvat Tov [...], and from there to the Hebron area and on to Jerusalem. The southern route led to Ezion-geber (Eilat). Travelling east took one to Edom and beyond, and to the west, the road led to Kadesh-Barnea." (Cohen and Yisrael 1995).

6.1. Major steps of the data-extraction process

- Step 1: Identify the ISO 3166 (RIPE 1997) country codes (in this case, for the area now comprising the modern day Israel) for the nodes in question.
  Result of the operation:
  IL
- Step 2: Identify a communication link between the first two nodes.
  Result of the operation:
  'En Haseva@IL = Horvat 'Uza@IL
- Step 3: For the purposes of electronic publication use the ISO 8859 (Ramsch 1994) Latin 1 Entities manual to encode in HTML any special characters or diacritics used in the placenames which were reported in the source document. For non-Latin characters use appropriate Unicode character sets (Unicode Consortium 1999).
  Result of the operation:
  [not applicable in this case, all characters are represented in plain text]
- Step 4: Remove blank spaces within the names of nodes
  Result of the operation:
  'EnHaseva@IL = Horvat'Uza@IL
- Step 5: Identify type of the route and overall geographical frame.
  Result of the operation:
  'EnHaseva@IL = Horvat'Uza@IL [L frame:'EnHaseva-Beersheva
- Step 6: Identify all other variables describing the link/route.
  Result of the operation:
  'EnHaseva@IL = Horvat'Uza@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
- Step 7: Describe remaining links from the same communication frame which are identified in the

source, repeat steps 1-5 as necessary.

Result of the operation:

Horvat'Uza@IL = HorvatQitmit@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
HorvatQitmit@IL = TelMalhata@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMalhata@IL = Tel'Ira@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Tel'Ira@IL = TelMasos@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMasos@IL = Beersheva@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]

- Step 8: Identify and describe any other links mentioned in the source; repeat steps 1-6 as necessary; provide annotations where necessary.

  Result of the operation:

  Horvat'Uza@IL = Arad@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]

  ....
  etc. etc.

- Step 9: Combine all transcribed data into a single list. Note down the total number of links. In this examples there are 13 unique communication links.

  Result of the operation:

  'EnHaseva@IL = Horvat'Uza@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  Horvat'Uza@IL = HorvatQitmit@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  HorvatQitmit@IL = TelMalhata@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  TelMalhata@IL = Tel'Ira@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  Tel'Ira@IL = TelMasos@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  TelMasos@IL = Beersheva@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  Horvat'Uza@IL = Arad@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  Arad@IL = HorvatTov@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  HorvatTov@IL = ??001@IL (near Hebron) [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  ??001@IL (near Hebron) = Jerusalem@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  'EnHaseva@IL = Ezion-geber@IL (mod Eilat) [L frame:'EnHaseva-Eilat unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  'EnHaseva@IL = Edom@IL [L frame:'EnHaseva-Edom unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
  'EnHaseva@IL = KadeshBarnea@IL [L frame:'EnHaseva-KadeshBarnea unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]

- Step 10: Copy the list resulting from Step 9. Invert the sequence in which nodes are listed. For example links 'A=B' and 'B=C' can be inverted and written down as 'B=A' and 'C=B'. Make sure that when describing travelling times across steep mountainous terrain, as well as for River and Sea routes [upstream travel or one against the prevailing winds (e.g. Casson 1984:185-186) takes longer] appropriate corrections and adjustments are made.

  Result of the operation:

  Horvat'Uza@IL ='EnHaseva@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]

  ....
  etc. etc.

- Step 11: Combine and sort alphabetically the original (Step 9) and inverted list (Step 10) of communication links. Ascertain that the resultant number is twice the value obtained in the step 9. In

case of discrepancies, trace the missing communication links, or remove any inadvertent duplicates.
Result of the operation:

'EnHaseva@IL = Edom@IL [L frame:'EnHaseva-Edom unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
'EnHaseva@IL = Ezion-geber@IL (mod Eilat) [L frame:'EnHaseva-Eilat unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
'EnHaseva@IL = Horvat'Uza@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
'EnHaseva@IL = KadeshBarnea@IL [L frame:'EnHaseva-KadeshBarnea unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
??001@IL (near Hebron) = HorvatTov@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
??001@IL (near Hebron) = Jerusalem@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Arad@IL = Horvat'Uza@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Arad@IL = HorvatTov@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Beersheva@IL = TelMasos@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Edom@IL = 'EnHaseva@IL [L frame:'EnHaseva-Edom unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Ezion-geber@IL (mod Eilat) = 'EnHaseva@IL [L frame:'EnHaseva-Eilat unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Horvat'Uza@IL = Arad@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Horvat'Uza@IL = HorvatQitmit@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Horvat'Uza@IL ='EnHaseva@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
HorvatQitmit@IL = Horvat'Uza@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
HorvatQitmit@IL = TelMalhata@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
HorvatTov@IL = ??001@IL (near Hebron) [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
HorvatTov@IL = Arad@IL [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Jerusalem@IL = ??001@IL (near Hebron) [L frame:'EnHaseva-Jerusalem unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
KadeshBarnea@IL = 'EnHaseva@IL [L frame:'EnHaseva-KadeshBarnea unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Tel'Ira@IL = TelMalhata@IL = [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
Tel'Ira@IL = TelMasos@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMalhata@IL = HorvatQitmit@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMalhata@IL = Tel'Ira@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMasos@IL = Beersheva@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]
TelMasos@IL = Tel'Ira@IL [L frame:'EnHaseva-Beersheva unspec trd av maj d000dd t000t a0600c QA1 (Cohen and Yisrael 1995) ILa0600]

- Step 12: Store the transcribed data online, in the form of a text or html file, give it a meaningful, fully descriptive name, for instance "ILa0600.html". Make sure that these data are freely accessible to other users of the Internet.
- Step 13: Provide the data set with ECAI-compatible metadata (Johnson 1999a) descriptors :
Result of the operation:

```
dc.title                          Middle East trade routes in 7th-6th c. BCE
```

dc.creator.PersonalName	T.Matthew Ciolek
dc.creator.PersonalName.Address	RSPAS, The Australian National University, Canberra, Australia [tmciolek@coombs.anu.edu.au]
dc.subject	trade routes
dc.subject	methodology
dc.subject	historical data
dc.subject	historical maps
dc.subject	cultural databases
dc.description	13 pairs of data points defing 7th-6th c. BCE. major trade routes across territories of today's Israel and Jordan
dc.publisher	www.ciolek.com
dc.publisher.address	Canberra, Australia
dc.date	1999-12-13
dc.type	Dataset
dc.format	WWW pages - static
dc.identifier	[domain and path details are listed here]/ILa0600.html
dc.relation.type	IsBasedOn
dc.relation.identifier	Cohen, Rudolph and Yigal Yisrael. 1995. The Iron Age Fortresses at 'En Haseva. www.asor.org/BA/Cohen.html
dc.language	en - English
dc.coverage.x.min	34
dc.coverage.x.max	38
dc.coverage.y.min	28
dc.coverage.y.max	32
dc.coverage.t.early	600[BCE]
dc.coverage.t.late	500[BCE]
dc.coverage.periodname	Iron Age
dc.coverage.placename	Middle East
dc.rights	Public domain
ecai.notes	Israel's geographic names follow the source's format.
ecai.notes	Symbols and abbreviations follow the OWTRAD Notation
ecai.team	Non-specific
ecai.themes	Archaeology

- Step 14: Provide the data set with a section on the data's "Version and Change History." There dates and details of all changes and corrections need to be explicitly stated. Maintain this section as necessary.

6.2. Transcription rules and commentaries

The above transcription process always requires some thought on the part of the person collecting OWTRAD data. Here are some preliminary rules, which have been found useful in the work carried out so far:

- Always try to simplify and ease your work. If you work with paper notes keep the amount of hand-writing to an absolute minimum. Take notes only of exceptions to patterns which have been already recorded. Remember that once you turn the handwritten notes into a word-processor file you can copy and paste and clone all the lengthy passages of repetitive passages of text easily and without errors.
- Focus on doing only one task at a time. Details which can be checked and resolved at later stages of work (e.g. the Internet code for a given country, or the preferred spelling of placenames) is to be handled only after the bulk of information has been extracted from a source in question.
- Whenever possible, work in conjunction with a detailed atlas. This helps to resolve terminology and topographical details. Remembe to resolve geographical ambiguities on the spot, at the time of data transcription, i.e., not at the time of data analysis.
- Data which are not present in the source map, should not to be added to the transcription without an appropriate marker. For instance certain geographical locations which may not have names on the source material (hence they should be initially marked as NN), but can be identified with the aid of reference materials, should have their name in the data set enclosed in square brackets []. This is to keep various layers of information (i.e. sources, additional reference materials) visibly separate.
- Undocumented background knowledge is not brought into the results of the transcription. This means that the transcription captures information from the source material and this information is carefully kept separate from transcriber's glosses and commentaries.
- Whenever possible, always use the source's geographical terminology as all place names can be subsequently converted into standard geographic names.
- When dealing with unidentified nodes give them a unique sequential number. This number is always meaningful within a context of a given data set, but does not need to do so across all sets.

- The notation's codes and abbreviations always should be introduced in response to the actual need, they are not to be created in an 'a priori' and abstract fashion.
- A far as the land routes are concerned all data are assumed to be symmetrical. What is true for the variable such as travel time in a link 'A=B' is true for the communication link 'B=A' as well. Note, that this assumption does not apply to Sea and River routes. Also, links traversing mountainous regions maybe affected by the difference in time needed to travel downhill, say, from Sarangkot to Pokhara, Nepal as opposed to the travel from Pokhara uphill to the village of Sarangkot.
- Routinely check your transcribed data - there is always a scope for improvement, for making the code shorter, clearer, more consistent
- Whenever possible, do corrections iteratively - first do a sweep to get rid of major problems. Then do subsequent sweeps to provide corrections of any minor problems. All affected data sets need to be corrected.
- Once a correction or improvement is implemented in one part of your transcript, see whether other parts of your emergent data set will benefit from the new improvement;

6. Putting the OWTRAD notation to daily work

Once a data set is established other steps also need to be taken. However, they are not an integral part of the OWTRAD notation itself. These steps are four-fold:

1. Register the data set with the ECAI Clearinghouse (Johnson 1999b) (www.ecai.org/metadata/).
2. Obtain the geographic coordinates for as many as possible nodes listed in the data set. For the lat-long values of some of the places reported in the "ILa0600" file see Appendix B below.
3. Maintain the newly created data set. Receive, evaluate and implement (if necessary) any corrections and emendations supplied by the users/readers of your online collection of data. Keep track of these changes in the "Version and Change History" section. Make sure that your email address can be easily located. Remember to confirm and acknowledge all input, however small.
4. Find ways of enhancing your specialization in a particular geographical and historical field. Find online collaborators from other fields. Encourage the sharing of data, technology and methodology. Jointly discuss and implement any corrections and enhancements to your operations. Find ways of building up online catalogues of high quality georeferenced placenames. Find ways for other people, however busy or unskilled, to contribute regularly to the growth and well-being of ECAI projects.

Between July and December 1999, in addition to creating the "ILa0600" data, the experimental notation was applied to a series of other sources as well. Altogether, the resultant data sets are as follows:

Table 4
Information about trade routes extracted via the OWTRAD notation

DATA-SET	REGION	DATE	INFORMATION	LINKS	SOURCE
ILa0600	Middle East	600 BCE	trade routes	13 links	Cohen & Yisrael 1995
XMEm0200	Mediterranean Sea	130 BCE	trade routes	46 links	Stone 1989
GRa0200	Hellenistic countries	350 BCE	trade routes	48 links	Scarre 1988
INa0100	India	100 BCE	trade routes	85 links	Stone 1989
EGm0200	Mediterranean countries	200 CE	trade routes	44 links	Stone 1989
XBLm0800	Baltic Sea	800 CE	trade routes	9 links	Humnicki & Borawska 1969a
CZm0800	Central Europe	800 CE	trade routes	15 links	Humnicki & Borawska 1969a
UAm1000	Ukraine	992 CE	trade routes	9 links	Humnicki & Borawska 1969b
PLm1150	Poland	1150 CE	major roads	169 links	Humnicki & Lalik 1957
PLm1370	Poland	1370 CE	major roads	43 links	Rutkowski 1980a
PLm1500	Poland	1500 CE	major roads	98 links	Rutkowski 1980b
INm1550	India	1550 CE	major roads	89 links	Farooque 1977
PLm1750	Poland	1750 CE	major roads	200 links	Rutkowski 1980c

On average, the OWTRAD transcription of a map or written document takes about one (1) minute per link, plus additional 10 to 30 minutes per data set to proof-read, correct, organise, annotate and place the extracted information online.
In the case of data sets listed in Table 4 they are stored on a web site at the address of the trial OWTRAD Project (www.ciolek.com/owtrad.html). The site is intended as a kernel for a forthcoming clearing house for electronic data on the land, river and maritime trade routes of Eurasia and Africa during the period 10,000 BCE - 1815 CE. The site consists at present (Jan 2000) of five interrelated parts:

1. an online copy of the latest version of the OWTRAD notation;

2. an archive of the collected data sets;
3. the beginning of a gazetteer of places mentioned in the above data sets;
4. the beginning of an online notebook with as much of 'intelligence' as possible and other factual data pertaining to physical, logistical and social issues involved in the circulation of people, goods and information. The notebook deals with such topics as Nodes; Communication links; Technology & Resources; Users; Logistics; Speeds & Endurance; Time budgets; Staging posts; Travel times; Loading capacity; Navigation; Effects of seasons; and, finally, Commodities & quantities.
5. a collection of research tools (ISO 3366 country codes table, ISO 8859-1 special characters table, a list of printed maps showing the course of various routes and roads)
6. a bibliography

All this information albeit fragmentary and incomplete, is placed online and made readily accessible to all interested users of the Net. The purpose of the site is three-fold. Firstly, it aims to provide readers with access to the current results of the methodological work-in-progress. Secondly, if freely offers collected data for use within and without the context of ECAI studies. Thirdly, it assembles together in a single spot the growing collection of tools necessary for the debugging of collected data (the intelligence notebook) as well as for their future georeferencing (the gazetteer).
By doing so I am hoping both to receive useful suggestions and critical advice, as well as inculcate among the scholarly users of the Net a custom of programmatic, free and selfless sharing of results of one's work, however minor and unimpressive they might be. It is my sincere conviction, that social science research will greatly benefit from the attitude of openness, trust, collegial help and unimpeded access to each other's workbenches. Whatever elements of academic mystique and impression-management are lost through this process, they are splendidly compensated by the increased speed with which we learn about each others successes and blunders and the opportunity to use each other's common sense and critical gaze, to correct rapidly (and inexpensively) all sorts of shortcomings in our scholarly work.

7. Conclusions

For the purposes of our work on the construction of trustworthy geo- and chrono-referenced digital data about human social and cultural behaviour the described attempt at a systematic study of trade routes is very much akin to the attempts of climbing a stone affectionaly known as the Eckenstein Boulder. Oscar Eckenstein was a famous British mountaineer of the turn of the 20th century and was one of the first people research and document techniques of climbing on rocks, snow and ice.
In summer 1956 Eric Newby and his intrepid friend, Hugh Carless were getting ready for, what they called, a "short walk in Hindu Kush". They did not have much time for proper mountaineering training. Nevertheless, they did not want to wander into the wilderness of Nuristan totally unprepared and totally unskilled. Therefore, they went to Caernarvonshire, Wales and spent quite a few anxious hours clinging upside down to the boulder learning first-hand about various moves and holds. Newby (1974:37) wrote about Eckenstein

> "He spent his formative years crawling over the boulder that now bore his name. Although it was quite small, about the size of a delivery van, his boulder was said to apparently embody all the fundamental problems that are such a joy to mountaineers and were proving such a nightmare to us."

An experiment undertaken between July and December 1999 and documented in this paper suggests that the problem of how to best identify, describe and adequately map various nodes, sites, links and routes (and if possible keep track of their major users and major commodities shipped across them) is complex but not overly complicated. It can serve, therefore, as a handy training device for all budding ECAI enthusiasts. The OWTRAD experiment suggests that information on various historical places and transportation routes can be easily located in and extracted from a variety of sources. The data-extraction process is fairly quick and painless. It does not involve any specialised technology nor extraordinary skills. It can be accomplished with the equipment and resources we all aready have. However, it requires mindfulness and attention to detail. It also requires that we subdivide the work into a series of self-contained stages, and that by the end of each operation we place our collected data online so that our collaborators can see them and, if possible, proof-read them and debug them (Raymond 1998, Ditlea 1999). Initially, our data do not need to be complete, or perfect, or fully standardised, or fully geo- or chrono-referenced. All they require, to start with,

that they start being amassed, that they are presented online in a simple, universally legible format, that they are fully referenced (with respect to the source they are derived from as well as the overall data set they belong to) and that they are made freely accessible to other people interested in the studied phenomenon.
In sum, the present work on digitisation of information on trade routes constitutes an intriguing and promising methodological exploration. Any part of it can be borrowed by any ECAI researcher and played with and modified at will. We need to experiment freely and play wholeheartedly with our methodological apparata, our tools and technologies, and with our data. It is only through frequent and frivolous interaction with each other and the results of our work that we can learn about our limitations quickly and painlessly.
We should start, however, with simple questions and even simpler materials. The study of trade routes falls into this class.
If we manage to figure out, all within the realm of ample and straightforward historical information, how we should conduct ourselves, as individuals and as members of the scholarly community, in order to collect detailed mappable data on various points and on various connections between them, the chances are that we will be able to figure out far more difficult methodological and organisational issues as well.

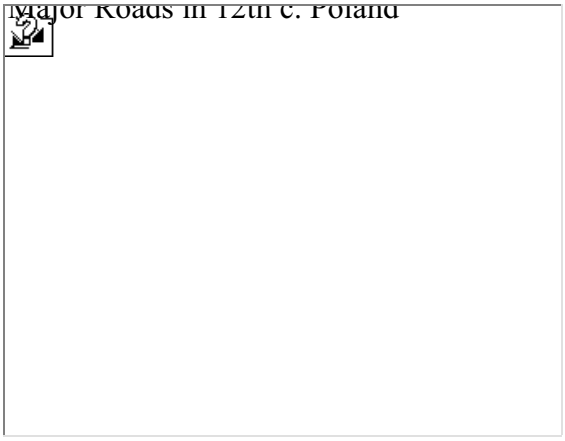
8. Appendix A - Types of information about trade routes

Information about communication links comes in four basic formats: graphic maps, anecdotes, itineraries, and finally, verbal maps.

i. Graphic maps

In this category of materials the geographic information is represented predominantly nonverbally, that is, through a combination of lines, points, areas, as well as various forms of colouring and patterning. Also, words are used, to identify and annotate inhabited places, mountain ranges, rivers, and other salient features of the landscape.

e.g., *Specimen no.1*:



A network of major and minor (dotted lines) roads in Poland during the 2nd half of the 12th c. (Humnicki and Lalik 1957) [JPG 98KB]

ii. Random written remarks

Possibly the largest category of materials is formed by accidental, almost haphazard remarks on various geographical points and their possible relationships. These remarks are made within a context of narrative or commentary which is focussed on some other issue:

Specimen no.2: a caption of a B&W photograph of a 12th c. CE milestone in Konin, half-way between Kalisz and Kruszwica, Poland:

> "Erected in 1151 by Piotr the Old Wszeborowic, the palatine of Kujawy. the milestone is placed on an ancient trade route (Amber Route) running across Polish territories via Jablonkowska Pass, Kalisz, Kruszwica and along Wisla River, to the Baltic Sea." (Wojtowicz 1956:253).
> [Coverage: 5 reference points, identifying a route approx. 630 km long]

or, an entry in a travelogue covering a 1950s' journey across Turkey, Iran, and Afghanistan:

> *Specimen no.3*: Bayazid...a "fortress town on the Persian Frontier; close to Ararat on the great caravan road from

Tabriz to Erzerum..." (Newby 1974:49).
[Coverage: 3 reference points, identifying a route approx. 650 km long]

Some of this intelligence can be, from time to time, more explicit and more deliberate:

e.g., a description of the route taken the Macedonian army in 4th c. BCE, at the outset of its campaign against Persia.

Specimen no.4: In early spring of 334 BCE Alexander's grain provisions "will have been carried by ship, and this is why the army's itinerary included the [Thracian] coastal towns of Amphipolis, Abdera, Maroneia, probably Aenos, and Sestos." (Engels 1978:28).
[Coverage: 5 reference points, identifying a route approx. 370 km long]

or, an account of the routes of the Roman merchants to the East, during an unspecified period CE.

Specimen no.5: "The most important of the east-west routes in the southwestern Asia ran from the Roman caravan center at Palmyra in Syria, eastward into Babylonia and on across northern Iran to Merv." (Curtin 1984:96).
[Coverage: 3 reference points, identifying a route approx. 3100 km long]

All these tiny snippets of information are, of course, of hardly any use on their own, in isolation. However, in conjunction with other materials, such as itineraries and maps (see below) can be used to construct and cross-check a rich and colourful mosaic of complementary factual data. These bits and pieces of factual data are very much like fibres of some plant material, such as hemp or cotton. If dealt with one at a time, they are extremely flimsy and not worth much attention. In larger numbers however, providing that they are tidied up, systematised and brought to a common denominator, they start forming strands of information which flesh out data derived from other, more substantial sources.

iii. Explicit written itineraries and lists

Another group of materials of relevance to the study of communication routes criss-crossing the world is made of various catalogues of places and itineraries. This category subsumes many primary texts, including the famous "Periplus of the Erythrean Sea" (Schoff 1912, Casson 1989) and the "Parthian Stations by Isidore of Charax" (Schoff 1914), first century CE professional guides to the maritime and land trading places linking the Mediterranean with India.
In these sources data pertaining to inhabited places and often, distances (measured as units of space or units of time), are systematically collected, ordered and stated explicitly, as a part of a longer manual, narrative or treatise:

e.g., an account of the routes taken by the Indian merchants while travelling to the N.West, during the 16-18th c. CE.

Specimen no.6:

Agra-Kabul route*

Important stages	approx distance in 'kos'**	sarais	forts	bridges
1.Agra				
2.Rankata	12			
3.Bad-ki-Sarai	10	sarai		
4.Agbarpor	12			
5.Hodal	13	sarai		
6.Palwal	12			
7.Faridabad	12			stone bdge
8.Delhi				
.....				
18.Shahabad	12	sarai	fort	
.....				
33.Lahore		many s.		
....				
41.Gujarat	2			
....				
60.Peshawar	8			
....				
73. Kabul	6	many s.	2 forts	

* The above table, taken from Appendix 2 of the book, is simplified here by tmc

**1 kos = 2 miles [approx. 3220m]
(Farooque 1977:216-220)
[Coverage: 73 reference points, identifying a route approx. 1850 km long]

or, a list of stopping places used by a group of guerrillas on the Arab Peninsula, in the first quarter of the 20th century.

Specimen no.7:

Date		Place
May 1917		
	.....	
	6	Wadi Hamdh
	7	Wejh
	9	Kalat el Zareib
	10	El Kurr
	12	Wadi Arnoua
	13	Abu Saad
	14	Abu Raga
	17	El Shegg
	18	Wadi Aish
	19	Dizaad*
	20	Wadi Abu Arad
	21	Bir Fejr
	.....	

(Lawrence 1997:662)

*Note: The distance between Dizaad and Bir Fejr, which Lawrence and his party of some 35 camel riders covered in 2 days (19-21 May) represents about 100 miles journey across the waterless terrain (Lawrence 1997:229-239).
[Coverage: 12 reference points, identifying a route approx. 390 km long]

Such detailed lists are very telling. Firstly, if plotted on a map, they tell us *where*, in a given area, are the customary stopping places for groups of travelling people. The presence of such stopover points is, of course, influenced by several variables (Engels 1978, Lewis 1997). Secondly, the list of recommended stopping places informs us about the distances and rates of daily march characteristic of a given category of travellers within the context of a given historical situation.

iv. Verbal maps

This category is made of materials where deliberate and fairly detailed accounts of two or more interlinked routes are presented in an attempt to discern and annotate all major component parts of the communication network in question.

e.g. or, an account of the roads in Western Anatolia, 1096 CE.

Specimen no.8: At the times of the First Crusade, "the road from Chalcedon and Nicomedia joined the road from Helenopolis and Nicaea on the banks of the river Sangarius. It soon left the river to climb up a tributary valley to the south, past the modern Biledjik, then wound over a pass to Dorylaeum, near the modern Eskishehir. There it split into three." (Runciman 1978:183)
[Coverage: 5 reference points, identifying a route approx. 300 km long]

or, an account of the routes of the unspecified merchants to the East, 13-14th c. CE.

Specimen no.9: "Since the 13th c. [...] most important was the road leading from Hungary to Gdansk; which ran from Krakow - the main node - via Bochnia and Nowy Sacz to Koszyce, (a side branch led from Sacz via Grybow, Biecz to Bardyjow), to the north it went through Piotrkow and Torun. [...] The route was Poland and Hungary's main link of with the countries of Western Europe.
A second important road led to the East from the Baltic coast. In the early 14th c. the main node of this eastern trade route was Wlodzimierz Wolynski, which with time, however, lost its prominence to Lwow. There were two roads from Gdansk to Lwow; the first one exited from Torun, ran along the right bank of Wisla and through Lublin; the second ran along the left bank of the river through Brzesc Kujawski, Radom and Sandomierz. From Lwow, via the Southern Ruthenia, a 'Tatar trail' led to Perekop, from which place one fork led across Crimea to Kaffa [mod. Feodosiya] and the second went on to Tana (on the lower Don), Astrachan and Central Asia. The Polish sector of this great inland route divided in two directions: Gdansk and Wroclaw. The latter city was linked to Lwow either via Piotrkow, Radom and Lublin; or via Krakow and Sandomierz; or Krakow, Bochnia, Tarnow, Rzeszow i Przemysl. The importance of the third of these segments started becoming apparent since the days of King Casimir the Great, and it was called the 'new road', to distinguish it from the 'old road', the one via Sandomierz." (Wojtowicz 1956:261-264, transl. T.M.Ciolek)
[Coverage: over 30 reference points, identifying several routes over a distance of approx. 2300 km long]

Not all verbal descriptions of terrain and roads, of course, constitute verbal maps. Some of the accounts

are too vague to count as such. For instance, H. Harrer wrote (1955:62):

> *Specimen no.10*: "When we first caught sight of it [Mt. Kailash] our Tibetans prostrated themselves and prayed. For Buddhists and Hindus this mountain is the home of their gods [...]. The faithful often travel thousands of miles to reach it and spend years on the pilgrimage. Pilgrim's roads converge here from all points of compass."

The above account offers an endearing, but an unmappable information.

9. Appendix B - Gazetteer of locations listed in the data set "ILa0600"

The materials below attempts to collection information on (i) place's **preferred (i.e. 'vernacular') name** (in bold characters); (ii) place's type (e.g. inhabited place, river, island etc.); (iii) the ISO 3666 code (RIPE 1997) of the country in which it is currently situated; (iv) latitude and longitude values; (v) decimal latitude and longitude values; and, finally, (vi) the list of it's variant names.
Some of these georeferences can be acquired online through interrogation of the Getty Research Institute's (1999) Getty Thesaurus of Geographic Names (TGN) or, for central European materials, of The Jewishgen ShtetlSeeker database (Tobias 1999). Other values can be located in such gazetteers as: Seltzer (1962) and his The Columbia Lippincott Gazetteer of the World [Contents: about 159,000 entries, with about 4,500 defined via lat/long coordinates]; Lloyd's Maritime Atlas (1964) [Contents: lat/long list over 5070 ports and shipping places of the World]; "The Times" Index-Gazetteer of the World. 1965 [Contents: approx. 345,000 lat/long locations]; International Geographic Encyclopedia and Atlas (1979) [Contents: 25,000 entries + index to the Atlas lat/long coordinates for approx. 14,300 locations]; and Willett (1984) The Prentice Hall American World Atlas [Contents: two indices - USA (about 29,000 lat/long locations) and the rest of the world (about 59,000)]. For sites not identified by the above gazetters manual calculations need to be made on the basis of the large-scale maps.
In this note latitude and longitude values which are derived from sources other than the Getty Thesaurus of Geographic Names (TGN) are noted accordingly.
Following the TGN convention, placenames are annotated with two capital letters, or "flags", in parentheses. These flags indicate the following: C for current name; H for historical name; V for vernacular name; and O for a variant name in a language other than the vernacular.

```
`Arad (inhabited place) IL
Lat: 31 16 N Long: 035 09 E
Lat: 31.267 Long: 35.150
Alternative names: `ARAD (C,V), Arad (O);
```

**Be'er Sheva`** (inhabited place) IL Lat: 31 15 N Long: 034 47 E Lat: 31.250 Long: 34.783 Alternative names: BE'ER SHEVA` (C,V); Beer Sheva (C,O); Beersheba (C,O); Bir es Saba (C,O); Beersheva (O);
Edom IL no TGN data no Bartholomew (1992) data
Elat (inhabited place) Lat: 29 33 N Long: 034 57 E Lat: 29.550 Long: 34.950 Alternative names: ELAT (C,V); Eilat (C,V); Elath (C,O); Eloth (H,V); Ezion-geber (H);
'En Haseva IL Lat: 30 48' 23" N Long: 035 14' 47" E [calculated by tmciolek from Bartholomew (1992)] Lat: 30.803 Long: 35.246 [calculated by tmciolek from Bartholomew (1992)] Alternative names: 'EN HASEVA
Ezion-geber IL => Elat
Horvat 'Uza IL no TGN data no Bartholomew (1992) data
Horvat Qitmit IL no TGN data no Bartholomew (1992) data
Horvat Tov IL no TGN data no Bartholomew (1992) data
Jerusalem IL => Yerushalayim
Kadesh Barnea IL no TGN data no Bartholomew (1992) data
Tel 'Ira IL no TGN data no Bartholomew (1992) data
Tel Malhata IL no TGN data no Bartholomew (1992) data
Tel Masos IL no TGN data no Bartholomew (1992) data
Yerushalayim (inhabited place) IL Lat: 31 46 N Long: 035 14 E Lat: 31.767 Long: 35.233 Alternative names: Yerushalayim (C,V); Al-Quds (C,V); Al Quds (C,V); El Quds Esh Sherif (C,V); Al-Muqaddas (C,V); J解usalem (C,O); Jerusalem (C,O); Gerusalemme (C,O); Jerusal嶺 (C,O); City of David (C,O); City of the Great King (C,O); Aelia Capitolina (H,V); Colonia Aelia Capitolina (H,V); Hierosolyma (H,V); Mount Zion (H,O); Urusalim (H,O);

10. About the Author

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can be found online at http://www.ciolek.com/PEOPLE/ciolek-tm.html

11. Acknowledgements

I am grateful to Monika Ciolek for useful discussions and critical comments on an earlier version of this paper.

12. References

[The great volatility of online information means that some of the URLs listed below may change by the time this article is printed. The date in round brackets indicates the version of the document in question. For current pointers please consult the online copy of this paper at http://www.ciolek.com/PAPERS/pnc-berkeley-02.html

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13. Version and Change History

- 3 Jan 2000 - added additional details of the OWTRAD web site
- Revisions, so far, incorporate minor editorial and markup fixes.

URL http://www.ciolek.com/PAPERS/pnc-berkeley-02.html