Two of the best-known data models are the relational model and the CODASYL model (sometimes called the DBTG, network, or data structure set model). There have been many efforts at comparing the two models and at defining mappings between them. The publications listed in this bibliography describe some of these efforts and some related topics. I invite readers' suggestions for additional entries for possible inclusion in a future bibliography. I omit publications on the more general topic of data base conversion.

Following each reference, I describe the publication briefly, usually by quoting parts of the author's abstract and/or main text. Often I supplement or replace the author's text with my own words, enclosed in brackets ([ ]). I do not guarantee that an author's abstract accurately reflects the content of the publication.

I do not evaluate the publications, nor do I guarantee the truth of their statements. Each publication may reflect its author's opinions. Also, because specifications have evolved over the last ten years, some statements may be out of date. The bibliography reveals that the authors have not reached consensus on equivalence of the models, nor on the models' relative merits, nor on the spelling of "data base".

The mention or lack of mention of specific commercial products does not imply endorsement or disapproval by the National Bureau of Standards.

The reader should have some familiarity with database management and with the two models. For background on the relational model, see sources such as:


For background on the CODASYL model, see sources such as:


For background on both models, see sources such as:


I thank John Berg, Joe Collica, Don Deutsch, Dennis Fife, Liz Fong, Len Gallagher, Alan Goldfine, Terry Hardgrave, Bel Leong-Hong, Chuck Sheppard, and Ben Shneiderman, whose libraries I raided innumerable times while amassing this bibliography. Terry Hardgrave and Matt Koll reviewed a draft of this paper. Several authors helped me obtain publications.

The annotated bibliography follows:
We are investigating here the problem of cooperation between several DBMS. This cooperation can take place, for example, via a computer network. We address ourselves especially to the description of a global view of several data bases. We have proposed some mechanisms to transform any program written in terms of the global view in programs which can be executed at the local data base level. [See also (Adiba, Deobel, and Léonard, 1976) and (Adiba and Portal, 1978)].

Here we examine how conversion can be made (in both ways) between network and relational concepts, using the DBTG-CODASYL and SOCRATE systems as examples. [See also (Adiba and Deobel, 1977) and (Adiba and Portal, 1978)].

We propose here a functional architecture of a cooperation system for heterogeneous DBMS in a network environment. [The paper assumes] the existence of different local data bases already in use under DBMSs like IMS, Codasyl-like systems, SOCRATE, relational systems, etc. The cooperation system should be able to provide facilities for creating and modifying a global view of these local data bases. [See also (Adiba and Deobel, 1977) and (Adiba, Deobel, and Léonard, 1976)].

System R is a database management system which provides a high level relational data interface. [One section of the paper explains that the interface] is designed in such a way that programs can be written on top of it to simulate 'navigation oriented' database interfaces. In general our strategy will be to represent each record type as a relation and to represent information about ordering and connections between records in the form of explicit fields in the corresponding relations. [Another section states that an] important access path is a binary link. Binary links are similar to the notion of an owner coupled set with manual membership found in the DBTG specifications. The main use of binary links in System R is to connect child tuples to a parent based on value matches in one or more fields. [See also (Lorie and Nilsson, 1979)].

The relational debate, as I see it, is over style in retrieval languages, and style, really, is only one aspect of a data base system. I accept the relational view and the data-structure-set view as being fundamentally compatible as they are applied in practice, and I'd like to demonstrate the equivalence between the two views.

The relational debate, as I see it, is over style in retrieval languages, and style, really, is only one aspect of a data base system. I accept the relational view and the data-structure-set view as being fundamentally compatible as they are applied in practice, and I'd like to demonstrate the equivalence between the two views.

This paper examines the Role data model as an evolutionary step forward in the sequence of data models and compares it with other data models.
[One section says] "I consider the relational model and the data-structure-set model essentially compatible and subject to transformation from one form to the other. "The relational model and the" [data independent accessing model] "appear to be completely at odds with each other". "By comparison, the data-structure-set model seems to be an effective hybrid between these two extremes".


"The ... system generates Fortran programs to retrieve data from a CODASYL database in the form of relations". "The system generates an internal description of a relation called a 'traversal', which includes elements representing both algebraic operators and CODASYL DML commands".


"The equivalence of data base states and data base schemas is defined". "It is shown, how a semantic data model and data definition language (LDDL) can be used to construct a correct specification of a translation function. Finally, an example of the translation of a CODASYL data base schema to a relational data base schema is given".


[This paper defines 'data model' and 'data model equivalence'. See also (Borkin, 1979)].


[This thesis defines equivalence of data models. Motivations include multiple data models for one data base, data transfer, and a global view of different data bases in a distributed system. The author states that with some restrictions upon the relational and CODASYL models, "the 'expressive powers' of the models are equivalent". [See also (Borkin, 1978)].


[In this data model,] "the logical view of the data in the database is essentially relational but with the superimposition of the owner-coupled set concept". "Extended Bachman diagrams in modified form can easily be used in the design of relational databases".


"An architectural approach is outlined ... in which any user in any network node can be given an integrated and tailored view of schema (e.g. hierarchical, relational), while in reality the data may reside in one single data base or in physically separated data bases, managed individually by the same type of GDBMS (e.g. CODASYL, IMS, relational) or by different GDBMS".

The entity-relationship model is fundamentally used for the highly logical model layers of the integrated system". [See also (Nahouraii, Brooks, and Cardenas, 1976)].


[In part of this paper, the author reviews different data models and describes support of multiple models on one architecture].


"A data model, called the entity-relationship model, is proposed". [One section of the paper describes how] "the entity-relationship model can be used as a basis for
unification of different views of data: the network model, the relational model, and the entity set model. "Possible ways to derive their views of data from the entity-relationship model are presented."


"This paper ... describes briefly how an ANST/SPARC three-schema data base system prototype could be constructed." "For the internal level we propose that a CODASYL data base management system be employed. The conceptual level will be a relational system."


"This paper is concerned with developing a methodology for designing optimal network data base structures". [Data description begins in the form of networks, which are converted into hierarchies, then into relations, then into canonical networks, and finally into optimal networks, based upon] "the set of queries," [using] "an operations research model". [See also (De, Haseman, and Kriebel, 1978) and (Haseman and Whinston, 1977)].


"Three principal types of language for data base manipulation are identified: the low-level, procedure-oriented (typified by the CODASYL-proposed DML), the intermediate level, algebraic (typified by Project MAC MacAIDS language), and the high level, relational calculus-based data sublanguage, an example of which is described". "Arguments are presented for the superiority of the calculus-based type of data base sublanguage over the algebraic, and for the algebraic over the low-level procedural."


"General purpose support for" [non-programming] "users entails provision of an augmented relatively complete retrieval capability without branching, explicit iteration, or cursors. It is clear how this capability can be realized with the relational approach. "It is not at all clear how the network approach can reach this goal, so long as the principal schema includes owner-coupled sets '-bearing information essentially'. A relational discipline is suggested as a way out for DBTG users."


"The programmer is provided with the ability to handle all three of the well-known database structures (relational, hierarchical, network), in a single integrated set of language extensions". "A database is represented, not as some new kind of input/output file, but instead simply as part of the program's directly addressable storage area". [See also (Date, 1977) and (Date, 1980)].


[One section of this chapter defines a language based upon (Date, 1976). In another section, the author argues that the relational model is simpler, and has a firmer theoretical base, than the CODASYL model. See also (Date, 1980)].


"The first description of UDL was given in" (Date, 1976). "The present paper provides an informal introduction to the concepts and facilities of UDL as currently defined ..., and thus forms a
replacement for the original paper".  
(See also (Date, 1977)).


"The purpose of this paper is to give some comparisons between these two approaches (primarily from the application programming viewpoint)"


"This paper suggests a method for building up a network database starting from relational descriptions. The network generated is optimal in terms of data item appearances and, given that, it is also optimal in terms of the number of records". "Some of the concepts ... are extensions of the ideas" (in (Clough, Haseman, and So, 1976) and (Haseman and Whinston, 1977)).


"A global schema is proposed for a generalised data base system capable of supporting interfaces to other systems -- notably Relational, Codasyl and Adabas -- through appropriate local schemas and data manipulation languages. The proposed global schema consists of entries in the form of normalised relations".


"The design and implementation of a generalized database management system based on the RAP database machine is described". "The E/R model is chosen as the Meta Data Model (Conceptual Schema) which generates external model interfaces consisting of the relational, network, and hierarchical models".


[This paper compares data base usage at] "three levels of description of data structures": (1) The implementation level or machine level, (2) A logical (semantic) level in which access paths are specified explicitly, and (3) A logical level in which only the relationships between data items are specified". [The second level is not specifically CODASYL].


"This paper attempts to bring out the similarities and differences clearly, by defining and discussing both models on a common basis of terminology". "Major conclusions are that (1) the two models are in practice not very different, (2) the relational structures are somewhat simpler than networks, but (3) the price for this is that the network model has more structural power, and more, not less, data independence than the relational".


"We have shown how to superimpose higher level structures on the records and record interconnections of a database, and how to use these structures for data selection and manipulation".


"We examined the semantic properties of a relationship between two entity classes". "We compared six data models with respect to the choices they offer for the representation of relationships".
This paper presents a taxonomy of basic data structures which cuts through and omits the secondary differences to highlight the most important logical differences. "The essential characteristics of each of six basic data structure models are described and each is exemplified using a common example". [See also (Auerbach, 1979)].

The idea providing coexistence of various data models and data manipulation methods within one database management system imposes new requirements on the design of such systems. "As a common basis for any external or internal interface, the use of a semantically complete and unique form of data -- the deep structure of data -- at the central interface is suggested. "Transformations from a deep structure into various semantically equivalent surface structures of data" [(CODASYL and relational)] "are shown".

"The equivalence problem between different data models of a database system is investigated. The notions of data-equivalence and consistency-equivalence are introduced. A specific solution to gain consistency-equivalence is proposed where the necessary changes of the data models are minimal. "This report [uses] "the relational model ... and the Codasyl DBTG model".

[One section briefly describes several data models and compares their terminology].
"FORAL is a non-procedural data specification and manipulation language based on binary associations. IDMS is a commercial database management system based on a 'network' model and belonging to the CODASYL DBTG group of languages. We describe an implementation of a subset of the FORAL query language over existing IDMS databases".


"This paper outlines a general philosophy and framework for the specification of a data model. Excerpts from scenarios that have been developed for specification of several well-known data models (e.g., DBTG, relational), "IDMS" are given and discussed. "The scenarios are intended for implementation of an augmented positional processor that will be able to support different data models". [See also (Rothnie and Hardgrave, 1976)].


"This paper describes a query language, QUEST, which provides a single interface to the three major data models. The initial development was aimed at providing a simple but powerful high-level interface for network databases. Subsequently, however, it proved straightforward to extend the semantics in a consistent way to include the hierarchical and relational models".


"This paper describes ERL a nonprocedural data definition language (DDL) for the entity relationship model (ERM) of a data base management system. Also described is the translator built to convert ERL programs into the DDL of SYSTEM 2000".


"A common data base architecture and its applications in supporting various language file systems and data base management systems are described. "Data base management specifications of 1978 CODASYL Journals of Development and of SQL 2 are extended. "Information preserving transformations between submodels within and across the models are specified". [See also (Johnson and Larson, 1979), (Johnson, Larson, and Lawrence, 1978), and (Larson, Johnson, and Lawrence, 1978)].


"This paper describes algorithms for translation (in both directions) between "minimally keyed" network schemas and "fully keyed" network schemas, and between fully keyed network schemas and relational schemas. See also (Johnson and Larson, 1979), (Johnson, Larson, and Lawrence, 1978), and (Larson, Johnson, and Lawrence, 1978)."

"This work concentrates on the problem of incompatible data models transformation, the criteria of correctness of such transformations, and methods of construction of correct transformations being defined". [See also (Kalinichenko, 1976)].


"Mapping is considered" [between] "n-ary relations" [and] "network data". [See also (Kalinichenko, 1978)].


"This paper investigates the possibility of accessing a DDLC database described by a DDL schema through a subschema presenting the user with a relational view of the database". "The argument will proceed by first describing some of the ways relations might be based on network structures yielding consistent effects on retrieval, and by then considering for each of these 'derivation rules' the effect of updating a relation".


"This paper classifies a collection of conceptual data models within a taxonomy framework consisting of the following parameters: graph theoretic versus set theoretic models, mathematical foundations, terminology, and semantic levels of abstraction".


"Accessing multiple, heterogeneous, remote Database Management Systems promises to be difficult because of differences in: i) the data model employed, ii) data structures constructed using this data model, iii) Database Management System functionality differences, iv) differences in Data Manipulation Languages used in interacting with the data structures, and v) computer system differences. Imposing a uniform user viewpoint across this collection of differences is an alternative to requiring detailed user knowledge of the characteristics of each of the accessed systems". [See also (Kimbleton, Wang, and Fong, 1979)].


"This paper describes" [a] "research project concerned with establishing the feasibility, issues, alternatives, and a technical approach for supporting a network data manager". "The basic assumption underlying the design ... is heterogeneity of data models, data structures, DBMSs, DMLs and computer systems on which these DBMSs reside". [The paper describes] "superimposing a uniform user viewpoint". [See also (Kimbleton and Wang, 1980)].


"Definitions of structure and operation mappings are given". [Mappings can be between schemas, between schema and subschema, between data models, between levels (e.g., logical and physical), or between multiple-node and single-node queries in a distributed data base].


"Features for the conceptual model are discussed". [This is based upon the language described in (Tsichritzis,
Three external models corresponding to the hierarchical, network and relational approach are mapped onto the conceptual model. [See also (Schmidt and Bernstein, 1975) and (Tsichritzis, 1975)].


"An intermediate data model is described which acts as a stepping stone to bridge the differences between CODASYL and relational data models. Information preserving transformations are described which may be mechanically applied to data definition or data manipulation statements of one data model to obtain equivalent statements in the other data model. Using these transformations it is possible to design a multimodel DBMS which supports both network and relational data models". [See also (Johnson and Larson, 1979), (Johnson, Larson, and Lawrence, 1979), and (Johnson, Larson, and Lawrence, 1979)].


"Paper compares the retrieval capabilities of HI-TQ, a non-procedural query language for Network type databases, to the Relational Calculus".


"This paper presents a brief tutorial on several of the more popular 'data models' or logical representations used in database systems to characterize the structural aspects of the database".


"We address the problem of executing high level language queries submitted to a relational data base system. As a step in the process of constructing an 'efficient' compiler for a high level language we suggest the elaboration of an intermediate level language acting as a target language for the optimizer part of the compiler". [The latter language can use tuple-at-a-time access, as does the CODASYL DML. See also (Astrahan et al., 1976)]


"At the declarative level of describing data, there is virtually no difference between networks and relations. At the manipulative level, the comparisons that we have seen today have been slightly unfair, in that one is comparing systems of a slightly different level of procedurality. The constraints imposed upon DBTG in defining language are the constraints imposed by COBOL".


"The paper presents a set of techniques for transforming structures of one particular 'data structure class (or DSC)' into equivalent structures of a second DSC. As the first DSC, we will take the Flat Data Structure Class. As the second DSC, we will take the class implicit in the data description language of the CODASYL Data Description Language Committee".


"An evaluation procedure is needed which will allow the user to evaluate alternative models in the context of a specific set of applications". "Two kinds of criteria are presented: use criteria, which measure the usability of the model; and implementation criteria, which measure the implementability of the model and the efficiency of the resulting implementation. The use of the criteria is illustrated by applying them to three specific models: an n-ary relational model, a hierarchic model, and a network model".

L. I. Mercz, "Issues in Building a Relational Interface on a CODASYL DBMS", G. Bracchi and G. M. Nijssen (Eds.), Data Base Architecture (Proc. IFIP TC-2 Working Conf. on Data Base Architecture, June 1974), North-Holland, Amsterdam, Neth.,
The CODASYL '78 database proposals are evaluated and found to be insufficient for providing a semantically complete, formal description for the conceptual schema. Therefore, it is not possible to derive a complete relational view from a CODASYL schema. In contrast with the CODASYL '78 proposals, a procedural external schema and related data manipulation operators are outlined, which can coexist with normalized relational views on the same information base.


The CODASYL DDL and Relational Data Model are compared. The comparison is illustrated with an example and some data descriptions. The main conclusion is that a common DDL could be specified, encompassing the main aspects of the CODASYL DDL and Relational Data Model. An instant guideline for DDL users [for relational-like use] and some DDL modifications are also shortly described.


[This chapter defines various aspects of the relational data model and compares them with aspects of the CODASYL data model. See also (Ollie, 1975)].


[In part of this paper], "the work of the CODASYL Data Base Task Group and of the groups which it has spawned is..."
compared with that of the Guide-Share
groups and with the emerging theories
on relational data bases. The
significant features of Codd's work are
selected and their potential impact
assessed".

T. W. Olle, "Data Definition Spectrum and
Procedurality Spectrum in Data Base
Management Systems", J. W. Klimbin and K.
L. Koffeman (Eds.), Data Base Management
(Proc. IFIP TC-2 Working Conf. on Data
Base Management, Apr. 1974),
285-293.

"This paper describes two spectrums -
the phys-log spectrum along which all
data definition languages must lie and
the procedurality spectrum along which all
languages to act on a computerized
data base must lie. A proposal for a
multi-stage data definition process
supported by different user interfaces
is outlined". [See also (Olle,
1974c)].

T. W. Olle, "Data Structuring Facilities
in Commercially Available DBMS", Computer
Bulletin, British Computer Soc., series 7,
no. 1, Sept. 1974, pp. 20-22 and 36.

"This paper introduces the new concept of
a complete spectrum of data
definition facilities from the purely
logical to the completely physical. An
indication is given of where major
commercially available DBMS lie in this
spectrum. The interaction with this
spectrum of processing languages on
various procedural levels is discussed.
Finally, a potential future role for
the relational database and its
associated processing language is
suggested". [See also (Olle, 1974b)].

T. W. Olle, "A Practitioner's View of
Relational Data Base Theory", PDDT, ACM
SIGMOD, vol. 7, no. 3-4, 1975, pp. 79-43.

"The ... paper represents a lightly
edited version of" [Olle, 1978].

J. B. Rothnie and W. T. Hardgrave, "Data
Model Theory: A Beginning", Proc. Fifth
Texas Conf. on Computing Syst.,
10, Dept. of Info. Syst. Management, U. of
Maryland, College Park, MD, Sept. 1976.

"We propose that 'data model' be used
to denote: a collection of abstract
terities, facilities for defining
abstract entities", and "a collection
of operations that manipulate abstract
entities". "This paper represents an
embrionic attempt to establish a theory
of data models". [See also (Hardgrave
and Sibley, 1979)].

J. B. Ruby and A. G. Carrick, "An Approach
to Providing a Relational Query Processor
for a Limited CODASYL Data Base Management System", Proc. 3rd USA - Japan Computer
Conf., AFIPS, Oct. 1975, pp. 139-144.

"A dual Data Base Management System
(DBMS) design is proposed within which
both network and relational subsystems
coeexist. The network subsystem serves
as the 'operational' DBMS with which
programmers interface, while it also
provides the base upon which the
relational end user (query only)
system operates". "The basic
network subsystem ... is a limited
subset of the 1976 CODASYL
specifications; and the proposed
relational query interface is a limited
subset of ... SEQUEL".

R. Rustin (Ed.), Proc. ACM SIGMOD
STG/IFIP Workshop on Data Description,
Access, and Control, vol. 7 "Data Models:
Data-Structure-Set versus Relational",
May 1974.

"This, the second volume, contains the
papers and the transcript of the debate
on the differences and similarities of
the Data-Structure-Set Model versus the
Relational Model of data between C. W.
Bachman and E. F. Codd". [This
includes six papers ((Bachman, 1974),
(Codd and Date, 1974), (Date and Codd,
1974), (Lucking, 1974), (Sibley, 1974),
and (Tsichritzis, 1974)) plus
discussion].

H. A. Schmid and P. A. Bernstein, "A
Multi-level Architecture for Relational
Conf. on Very Large Data Bases, ACM, Sept.

"We describe a multi-level architecture
for relational data base systems".
[One level supports the language
described in (Tsichritzis, 1976). See
also (Klug and Tsichritzis, 1977) and
(Tsichritzis, 1975)].

L. S. Schneider, "A Relational Query
Compiler for Distributed Heterogeneous
Data Bases", Sterling Systems Corp.,
Golden, CO; presented at SHARE 50 Conf.,

"Information systems in which the
database is distributed among many
heterogeneous representations are
becoming more common with the advent of
computing networks". "This paper
contains that a mapping from a
consistent comprehensive user-view to the semantics of each target system involved would reduce this problem to one of syntax for which known solutions may be applicable, and that such a mapping can be founded on the relational model ..., the Data Independent Accessing Model ..., and the juxtaposition of these". [See also Schneider, 1976].


"This paper attempts to show that the DIAM's relevance to contemporary research in database systems can be enhanced by viewing it through n-ary relations. To accomplish this, the paper first develops a redefinition of the DIAM String Level in terms of n-ary relations. It then appeals to the remaining levels of the DIAM to describe various relational implementation alternatives". [See also Schneider, 1976].


"This paper presents and motivates the DAPLEX language and the underlying data model". [One section states that] "the data modelling capabilities of DAPLEX incorporate those of the hierarchical, relational and network models".


"Our efforts to develop an automatic database system conversion facility yielded a powerful, yet simple query language which was designed for ease of conversion". "This approach provides for a high level, relational-like facility with the visual and structural appeal of the network model". "Within a set instance the records are in ... order by the set keys" [as in a CODASYL set] "and duplicate set keys are not allowed" [as in a relation, whose tuples are unique, or a CODASYL set with duplicates not allowed].

E. H. Sibley, "On the Equivalences of Data Based Systems", in (Rustin, 1974), pp. 43-76.

"The two major approaches that have emerged may be termed the relational or set theoretic, and the data structured or procedural. There are obviously differences in these, but there are also similarities".


"In the past, attempts have been made to compare and contrast ... systems, but the greatest difficulty arises in seeking a common basis. This paper attempts to show how a generalized data system (GDS), represented by two different models, could form such a basis; it then proposes that data policy definitions can restrict the GDS to a specialized model, such as a relational or DBTG-like model".


"The three models of data that currently prevail are described. One is the relational view". "The second is the network view advanced by CODASYL". "A third view is a hierarchical one". "Non-procedural languages for all three views of data are very similar". "The expressiveness of the data structures is the same for" [relational and network].


"Many data base query languages, both stand-alone and coupled to a general purpose programming language, have been proposed". "Issues include the specification of performance options, side effects, implicitness, the handling of types and the time of binding". "The emphasis is on a comparative analysis".

"We propose a philosophy of a Data Base Management System (DBMS) for a composite type of distributed data base. Component data bases being to construct the distributed data base ... may have data models different from one another. We integrate various kinds of data models into the relational model to construct the distributed data base".


"Which is the most convenient database model considering specific applications? The goal of this paper is to try to answer this question by the use of a chemical example. Examples of requests describe the problems of insertion, deletion, and updating; these requests are analyzed for the hierarchical model and are expressed in a relational language defined by the authors and in Socrate for the network model".

D. C. Tsichritzis, "Comments on Advantages of the Relational View", in (Rustin, 1974), pp. 77-81.

"The principal advantages of the relational model are: simplicity, in terms of the data and the language; uniformity, everything is based on one concept; completeness, it is as complete as anything else; data independence, both in storage structure and growth independence for certain kinds of changes in the schema; security and integrity".


"This paper presents the main ideas behind the language LIL. It can be thought of as a relational system implemented on a network environment". [See also (Klug and Tsichritzis, 1977), (Schmid and Bernstein, 1975), and (Tsichritzis, 1976)].


"A network model is defined in terms of simple relationships among data". "A network language is proposed to declare and manipulate access paths between data. It is claimed that the proposed framework can be appropriate as a basis for relation implementation". [See also (Klug and Tsichritzis, 1977), (Schmid and Bernstein, 1975), and (Tsichritzis, 1976)].


"By the criterion of easy use, there is no doubt that the relational model is superior". "When we consider the potential for efficient implementation, the network and hierarchical models score high marks".


"Data translation and transaction translation are two major problems that have to be solved in order to achieve the coexistence of heterogeneous distributed databases". "Methods for mapping a hierarchical or network schema to an equivalent relational schema are presented". "Relational operators ... are translated to equivalent hierarchical and network operations".


"The relational data model ... has been contrasted with the CODASYL DDL network model as to effectiveness in meeting the goals of data independence, flexibility in data modeling, and ease of use". "The CODASYL DDL and DML interfaces are oriented to the application programmer whereas the
relational model is oriented to the less procedural non-programmer. This paper proposes an application programmer COBOL interface for the relational model utilizing existing COBOL I/O verbs and the CODASYL DDL constructs of schema and subschema".


"In part of this paper", "the concepts of modeling information structures with data is illustrated with the CODASYL DRTG and the relational models".


"A variant of the Entity-Relationship model is proposed as the data model for logical design". "Mapping rules will be proposed for transforming a design schema into a corresponding schema of either relational or DRTG type". "It is shown that with relatively minor semantic augmentation of DRTG and relational data models, the mapping is reversible. As a consequence, reversible schema conversion between DRTG and relational models becomes possible".


"In a multilevel database architecture, authorization rules may be written at the conceptual level or at the external level. We analyze here the consistency of authorization rules written at these two levels. We assume that the conceptual level model is of the entity-relationship type and the external model is relational".


"An algorithm is presented for designing relational views over network schemas". "The particular declarations of a CODASYL schema which supply sources of logical data definition are first identified. Then the view design algorithm is derived on the basis of a formal analysis of the semantic constraints established by these declarations. A new form of data structure diagram is also introduced to visualize these constraints". [See also (Goldman, 1979), (Zaniolo, 1979b), and (Zaniolo, 1977)].


"The problem of designing and supporting relational and hierarchical views over CODASYL network schemas is considered". "A solution is proposed based on the integrity constraints on logical data resulting from certain declarations in the CODASYL Data Definition Language". [See also (Goldman, 1979), (Zaniolo, 1979a), and (Zaniolo, 1977)].


"The relational model is extended to include null values and operations on relations containing null values. These concepts allow the definition of information preserving relational views over a network schema. A mechanism is presented to support queries on these views without duplication of actual data". [See also (Goldman, 1979), (Zaniolo, 1979a), and (Zaniolo, 1979b)].


"The problem of data base access via different data models has been investigated for the network model and the relational model. The network model is based on ... Codasyl. ... For a given network model of the data base a coexistent relational model is proposed. The proposal is based on an extension of the usual relational model ... by an incorporation of appropriate network parameters".