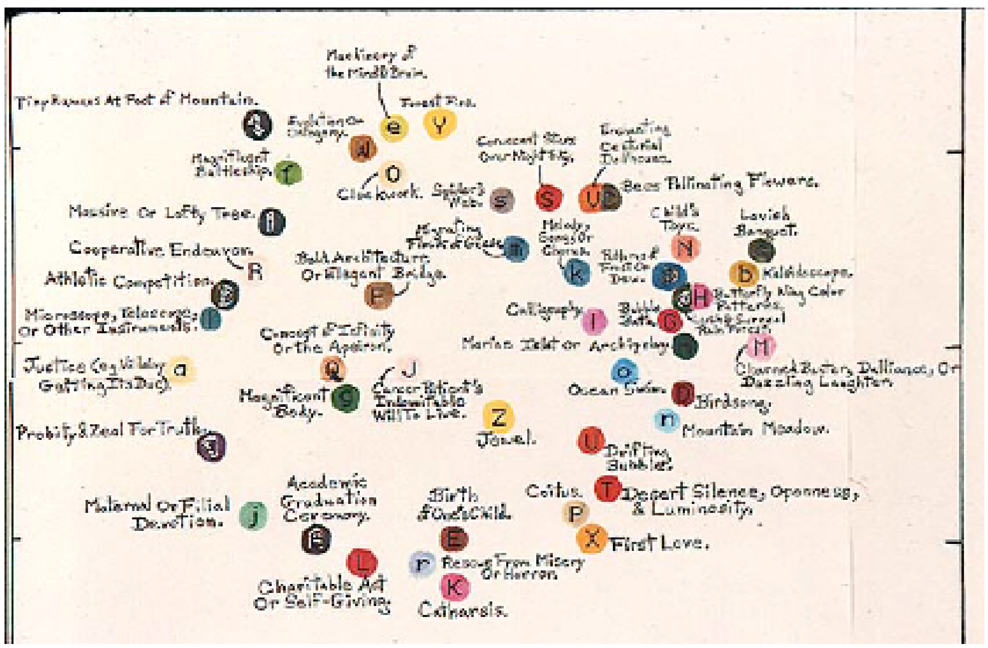
Metagraf2: Creativity, Beauty
towards the Gestalt...



MDS map for aspects of beauty by P. Gunkel (http//ideonomy.mit.edu)

20 Oct 02

11.0 Modes of Thought

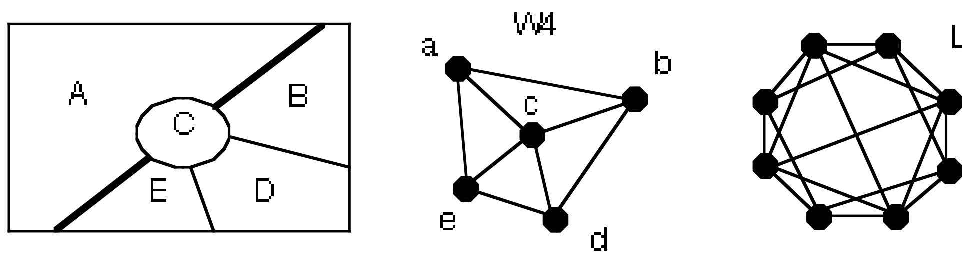
Metagrafs have a dynamics, which anigraf models do not. Transformations along paths imply movement; similarities between pairs are solid relationships. If there is a dynamics to a relationship between anigraf models, then this dynamics takes on a metagrafical form in its own right, with model transformations that continue except at a terminus. Changing parameterizations, root nodes or foci -- all cause a restructuring of dynamical form. Elements of events seen before as positive can all of a sudden become negatives. Recasting forms in a fixed context, as in the complements of Fig. 10.4, or altering the context to change perspective on a form, as in Fig. 10.0, are cognitive operations that reshape thoughts. We see the prevalent use of analogs, or of changes in depictions, or new perspectives gained through a change in context. What laws govern this space of cognitive inquiries ? More importantly, by understanding the constraint on cognitive operations, can shackles be broken to gain freedom for greater creativity ? Can this be accomplished without a total break from reality ?

11.1 Beyong Grafs

Graphs are but one of many possible representational forms useful for comprehending world properties. Logics, Algebras, Groups, Geometries, Probabilities are some of the other possibilities we have invented. Many of these alternatives have first-order mappings into graphs. But just as language-based descriptions of events can never be identical to pictorial forms, or vice versa, both representations are useful, and often are brought together to obtain more expressive power. Such assimilation again rests heavily on the belief that the world is consistent and has structure. Events are not random but can be placed into categories; properties of objects are highly correlated. As a consequence, anigrafs will have similar models, thus fostering a society of shared beliefs.

Fundamental (Mode) Hypothesis: The world has structure; within any context, at any space-time scale, properties are highly correlated.

This hypothesis becomes a crucial element in model-building. Even if representations are different, any modal coherence of properties will tend to drive the nature of the parameterizations within the representation. These, in turn, will provide bridges that link one representational form to another. We illustrate by relating categories expressed as a maps into graphical forms and vice versa.

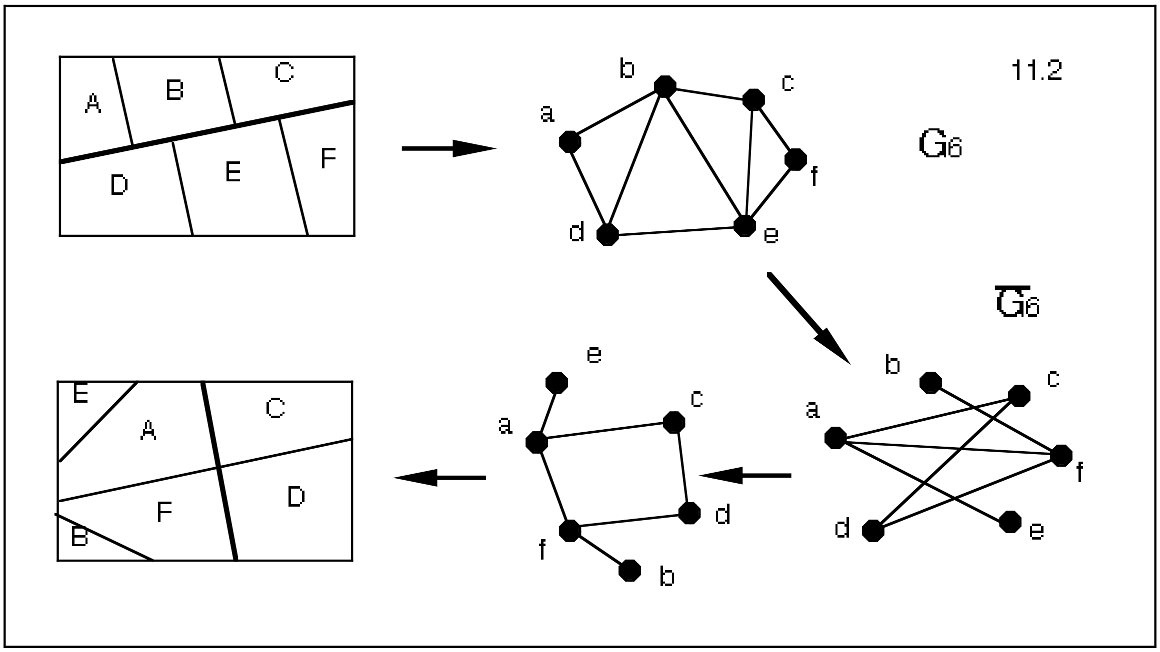


11.1

11.2 Maps and Modes

For visual creatures, spatial maps or diagrams are often useful because metrics and layouts are more vivid. Figure 11.1 illustrates two such mappings. W5 has mapped regions into vertices; L8 maps edges in the map into vertices (i.e. it is the line graph of W5.) Neither of these representations is equivalent to the map. For example, note that the AB and AE boundaries in the map are collinear, but this alignment is not explicitly expressed in the graphical depictions. These alignments indicate parameterizations of the domain -- so called modal correlations of properties. Hence when these are important for a task, or if area factors are of concern, then the pictorial map is the more vivid choice.

A second example is shown in Fig 11.2. Here there is one mode line separating {ABC} from {DEF}. The corresponding (frame-free) planar graph is G6 to the right. The relations between regions are captured, but not the modal boundary. Yet, just like language can serve to guide pictures, so can the graphical representation provide a “metagrafical” tool for manipulating the map in non-obvious ways. The line graph L8 above is one example. Another would be to use the anigraf's notion of a complement of a graph, but applied to the map. Perhaps such structures, like the graphical, star-like complements of rings, will be meaningful and provide new insights into (complementary) aspects of the anigraf world.



Consider the six-sector map again. Given the related graph G6, we can form the complement G6 . This graph in turn can be untangled, and then regularized according to the initial rectangular frame. The result is a complement of the original map. Note that two new "mode" boundaries appear, based on those regions maximally separated. The anigraf's view of the domain has been complemented, or "inverted." Such manipulations at the metagraf level often break bonds on mental thoughts and go beyond the current zeitgeist, leading to new creative insights. For example, what if the map of Fig 11.1 were to be inverted ? Because the central region "C" is adjacent to all other regions, the equivalent graph is covered. Hence on inversion, this node vanishes, having no connection to any other node. There is thus a curious complementarity between the origin of a configuration and its distant infinity.

11.3 Ideonomy

Just like the world has modal structures, so must the anigrafs models to support the sharing of knowledge and basic communications. Although attempts to discover laws underlying modes of thought date from at least Plato, Francis Bacon was the first to suggest that there could be a science of concept creation. Was number theory simply the product of bartering and exchange ? Are the concepts like i, e, pi, root 2 just the result of building "tidy" models ? Ideonomy is the term coined by Patrick Gunkel to describe the study of the laws underlying conceptual spaces. Metagrafs are examples of ideonomic forms. At the highest level, they elaborate D'arcyThompson's analysis of biological forms, and reveal similarities between many conceptual models, such as "emotion" and movement, classical atomic structures and galactic form, or quantum potentials and black holes.The goal is not simply to discover new, unexpected relationships, but more importantly, to recognize the inherent simplicity of the relation between the old and the new. Although a new Gestalt may be associated with a set of relationships seen as a whole, there is simultaneously the recognition of its distinct subpatterns, and how the relations among the subpatterns relate to the whole. In other words, there is an "understanding" that encompasses several levels of relationships at several scales (or anigraf groupings.) The parts all blend into the whole to create the Gestalt. At present, no compelling, formal models have been discovered for this metagraf Gestalt. Gunkel's ideonomy (ideonomy.mit.edu) is a preliminary step, the tools and conceptual capabilities are still very impoverished. One area of continued interest is beauty. Cerillo (1965) emphasized group structures for music and art. Here, we take a different tack, more closely related to anigraf design.

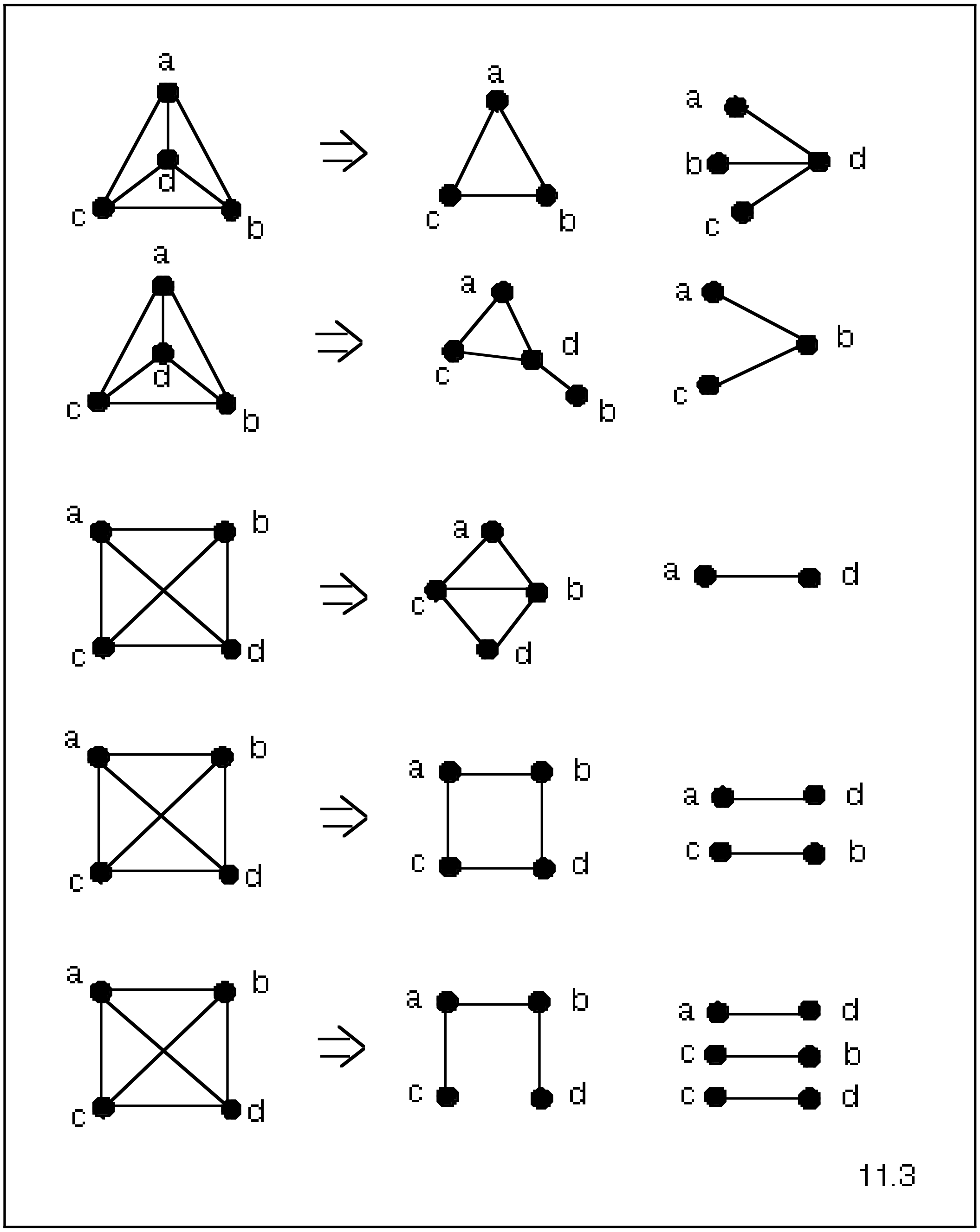
11.4 Beauty

Although aspects of beauty can be shared in a society, fundamentally it is a personal experience. Hence revelations or insights are often experienced as "beautiful", demonstrating that one's own perspective and intrinsic structures play an important role. The breadth of what may be considered beautiful is enormous. A creative act, or a simple mathematical expression is more than just elegant. There is the beauty of true love, or the beauty of a sunset, a forest, a seashore. Music, design, poetry all may evoke feelings of beauty, depending upon the context and the beholder. What, then, might be considered the core of beauty in anigraf world ? Is there any set of relationships that might be common to all forms of beauty as entertained by anigrafs ?

Definition: *Anigraf Beauty* is when many different relationships are seen not only in an entirety, but are also appreciated as a variety of interrelated decompositions of the whole.

More simply put, using the grafical representation, at one level there is a unification of all relationships, such as depicted by Kn, whereas at other levels, there are sets of subgraphs, each of which fit together seamlessly (to the anigraf's view), yet can be reintegrated into the whole, which is then broken down into yet another set of subgraphs. In the human mind, a prevalent example would be the beauty of the conviction that there is one overarching "God" possessing an all encompassing love for all creatures, who are seen in his image striving for loving relationships with each other. Another example would be how a scientist might view (or believe in) explanations of the world about us, from its very atomic or galactic core to life itself. Yet another, on a more mundane and less awsome plane, would be the interconnectedness of the pieces of a musical composition, a poem, or a story. In all these cases, the significant events are tightly interwoven and complex, yet still are felt to be an integrated, coherent whole. In anigraf world, we can explore this "model" for beauty a bit more precisely.

As before, any event or property is represented as a node in a graph, with edges indicating a close relationships. Of course, these relationships may change with time as graphs evolve into new structures. However, at the abstract level of metagrafs, these evolutionary steps should result in new graphical forms (or subgraphs) that are in the metagraf set, otherwise they will be unfathomable. So our challenge for anigraf beauty is to understand how accepted metagraf forms (ie models for events & relationships) first



11.3

can be seen as subgraphs of Kn, and then re-evolve into yet another set of decompositons, or augmentations, if Kn -> Kn+1.

11.4.1 Simple example.

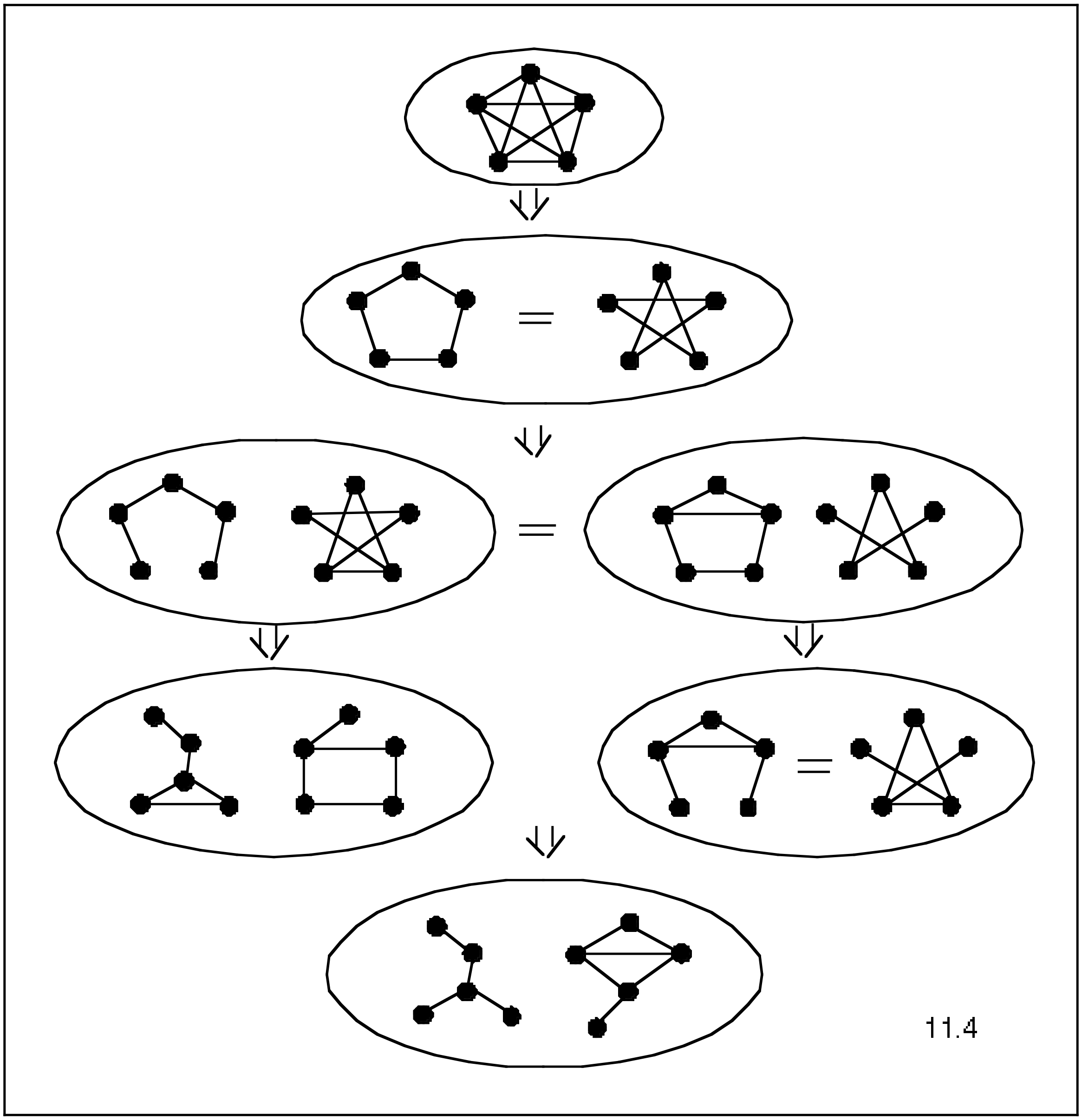
The key here is that beauty is about relationships, not the form of the objects themselves. Rather, the nature of the objects is assumed to set the context, thereby influencing the observed relationships. The basic idea is best illustrated with K4. There are five different kinds of subgraphs that result when an edge is removed from K4. These, and their residuals, are shown at the right in Fig. 11.3. For clarity, two depictions of K4 are used, one having a triangular outline, the other a square. At the top, we have K4 = K3 + t3. Indeed, for any Kn, it is obvious that Kn = Kn-1 + tn-1. Hence any Kn can be decomposed into a (non-unique) set of trees. In the third row of the figure, K4= R4 + {gi}, where gi in this case are two versions of K2. Still more possibilities are given in the remaining rows.

From the point of view of these graphs seen as patterns, there is nothing especially striking about these decompositions. For example a ring and two edge segments with nodes seem quite distinctively different and hard to "relate" to one another. Perhaps the strongest relationships are the top two triangular forms in the second column, and the two square rings below. Ideally, we would like the subgraph decompositions of Kn to be have more compelling relationships. Such a metagraf that organizes the objects in Fig 11.3 in a meaningful way is obscure.

11.4.2 Complementarity

A different tack would be to break down Kn into relationships that are already part of the anigraf's repertoire. Graphical complements are an option.

Let Kn be divided initially into complementary pairs having as nearly as possible the same number of edges thus creating an "equal" partitioning. Then proceed to manipulate these pairs by adding an edge to one, and removing an edge to the other. Figure 11.4 shows this result for K5. Note that for the anigraf, the initial split is very compelling in this depiction. The transitions seem to follow rather well. The entire structure is a candidate for the metagrafical organization of K5, seen as a decomposition of connected subgraphs of order 5. (The lower orders follow trivially.) Perhaps one kind of "beauty" associated with K5 are these subgraph relationships. Of interest is that all of these decompositions contain the chain C4 as a subgraph.



11.4

Seeing this common element offers further insights. Perhaps at the root of beauty is the appreciation of such a common element to any decomposition of the whole.

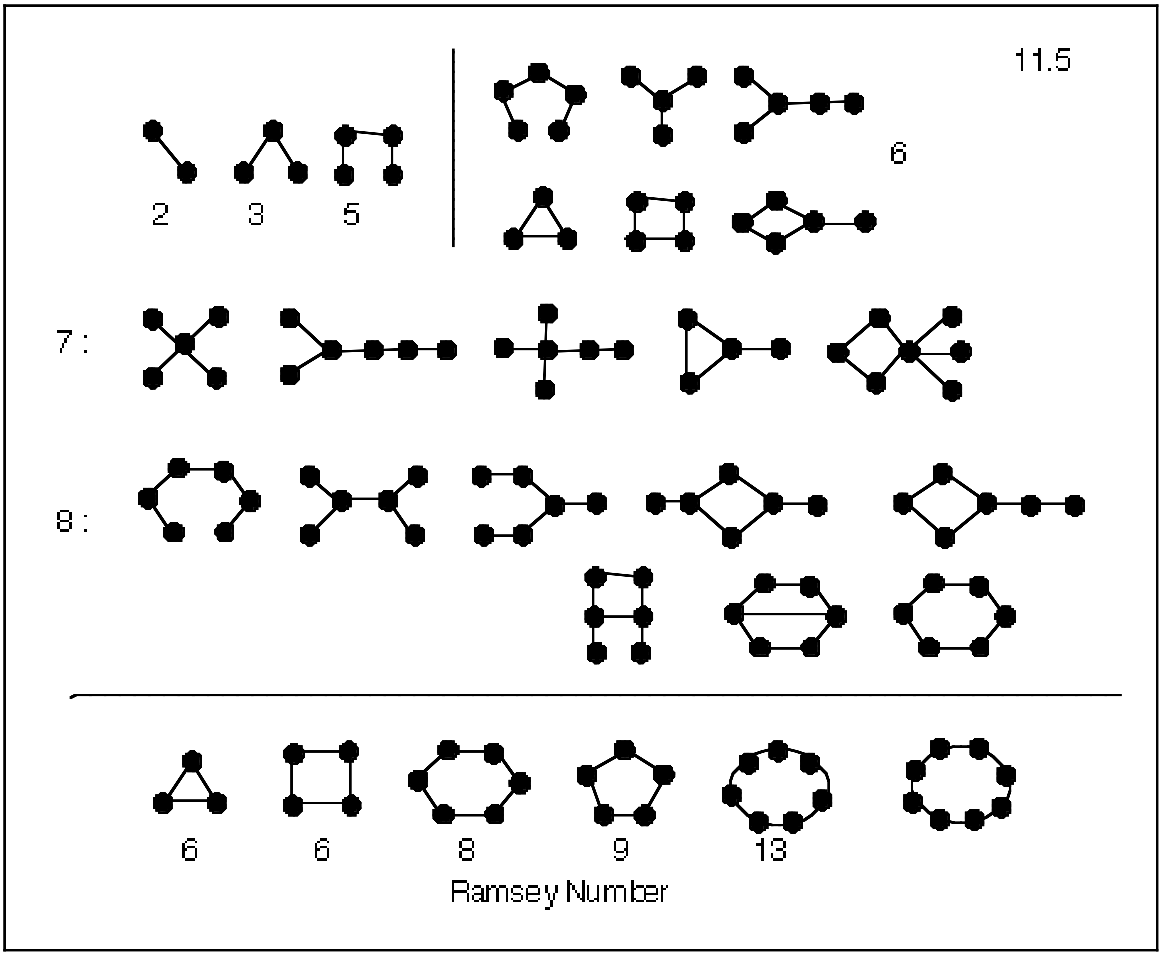
11.4.3 Ramsey Decompositions

Given n objects under consideration, let the edges of Kn represent all possible bidirectional (non-metric) relationships. We now ask, given any decomposition of these edges into two sets, is there a connected subgraph always guaranteed to be present in at least one of the decompositions ? If so, then those subgraphs present for Kn but not appearing in decompositions of Kn-1 will be designated the "atoms" for Kn. Clearly one element of a chain, namely C2, is the simplest atom (seed?),but does not qualify as an atom for Kn, n>2. Hence the atoms of special interest are the "largest" for any Kn -- those which appear first for Kn but not for Kn-1.

Definition: The *"atoms" ån for Kn* are the connected subgraphs that are present in at least one member of all binary decompositions of the edge sets of Kn, but are not present in all such decompositions of Kn-1.

By definition, the atoms ån are thus those connected graphs associated with the diagonal Ramsey numbers r(G,G) where r = n. Part of this set is shown in Figure 11.5.

Not surprisingly, most of these atoms have appeared throughout the text. Simple trees and rings were the building blocks for primitive anigrafs. The impact is that for ***any*** system of n "objects" built upon relationships, then these must be the expected prevalent forms, because they survive any decomposition of the complete set of relationships. Hence we can now place a new, more meaningful ordering on the trees and graph with rings. For example, ring shapes are now not ordered by the number of edges, but by their Ramsey numbers. As shown in the lower portion of Figure 11.5, the hexagon is "simpler" than the pentagon . Furthermore, there is an appealing progression of triangles or square subgraphs with tails -- very reminiscent of how cellular animate anigrafs "evolved." As Eddington noted: "We have been walking down a freshly washed beach and have come upon a set of footprints, which, upon more careful inspection, we recognize as our own."



11.5 The Unattainable Self

The transcendent nature of beauty provides a model for a being's sense of "wholeness". The anigraf argument is based on an agent having preferences for the next state of the system, rather than simply choosing a local action. The sharing of such preferences among agents creates a host of mini-models for various aspects of the system's activities. When all models are integrated together, one obtains a large, complex model not accessible to any one agent. Any agent-based self-reflection has no capability of seeing "the whole." Nevertheless, for successful communications, each agent needs to understand to some degree the variations on its own model that are held by neighboring agents. If these variations "make sense" as an extrapolation of or a revision of an agent's own model, then this knowledge can provide glimpses of a more complete whole that will transcend one's own immediate knowledge. The "whole' is there, but unattainable. The situation is quite analogous to "beauty."

A natural question in this era of computation-based modeling is whether a sense of conscious self can be created in a machine. Certainly all that has preceded in anigraf design can be embodied in an information sharing device built from non-biological components. Obviously, there will be enormous problems as to how each agent acquires the goals of the system of which it is a part, as contrasted with the much easier task of learning simple, local, vehicle-like actions. But assume this formidable learning task is mastered. Then would such a machine experience self-awareness ? Again, if components had adequate models of agents with which they interacted, then we can envision programs that would compare model similarities and be capable of extrapolating further beyond these immediate models, just as was done for metagrafs and beauties. This ability would have to reside within each (or many) agent systems, giving each agent system a sense of a whole (by definition) transcending their immediate knowledge. Thus, a sense of self has to be tied closely to collective consciousness as embodied in any anigraf-like entity.

The rub is that for complete self-consciousness, each agent needs knowledge not just about its neighbors, but about all participants. In other words, each agent needs a complete model of the system as a whole. As systems become more complex, clearly the capacity to integrate all agent viewpoints diminishes. Unless agents themselves become exponentially more powerful knowledge structures, the sense of "self wholeness" must diminish. Except for very simple and limited systems, a "complete" self awareness is unattainable.