When Douglas Hofstadter took over Martin Gardner's column in Scientific American, he changed the name from MATHEMATICAL GAMES to METAMAGICAL THEMAS. The new name is an anagram of the old one, that is, a permutation or reordering of the same set of letters. This naturally suggests the question of how easy it is to find an anagram on these letters which "makes sense".

Some sets of letters (such as XJRMQ) will form no English words or phrases at all, though the die-hard may find the call letters of a Mexican radio station! Some sets of letters (such as those in the word FLANK) will form only two (NIGHT, THING); some will form several (POST, POTS, SPOT, STOP, TOPS, OPTS). How many "meaningful" expressions can in fact be formed from the 17-letter set AAAACEEGHHIMMMSTT, the letters in MATHEMATICAL GAMES?

First, the purely mathematical question: how many distinct permutations of these 17 letters are there, whether they make any sense or not? If all 17 letters were different (which they clearly are not), the number of permutations would be 17!, pronounced "seventeen factorial," and defined to be $17! = 17 	imes 16 	imes 15 	imes 14 	imes 13 	imes 12 	imes 11 	imes 10 	imes 9 	imes 8 	imes 7 	imes 6 	imes 5 	imes 4 	imes 3 	imes 2 	imes 1 = 355,687,428,096,000$. Because there are repeats among the letters, we must divide this number by the number of ways of permuting identical letters among themselves (since interchanging identical letters produces no visible change in the resulting sequence). The four A's can be permuted in $4! = 4 	imes 3 	imes 2 	imes 1 = 24$ ways, the three M's in $3! = 6$ ways, the two E's in 2 ways, and the two T's in 2 ways. Thus the total number of distinct sequences of the 17 letters in MATHEMATICAL GAMES becomes $17!/(4!3!2!2!) = 617,512,896,000$. This number is increased if we have the option of introducing spaces between words and punctuation marks wherever we wish in the sequence.

How many of these mathematically distinct sequences are likely to make any sense as English? This is a question for Information Theory, which reformulates it as follows: What is the entropy of written English, regarded as a source of letters of the alphabet? (Entropy is a measure of the permitted degree of randomness.) If written English had an entropy as large as $\log_2 26 = 4.76$ bits per letter, that would mean that essentially every sequence of letters is "meaningful". We know this is far from the case, and the best estimates of the entropy of written English are in the range of one to two bits per letter. This would suggest that there are between $2^N$ and $2^{2N}$ meaningful English messages which are N letters long, and in particular, between $2^{17} = 131,072$ and $2^{34} = 17,179,869$ for sequences of large mutations of the upper and lower case. For large permutations of the English alphabet, for language with the typical characteristics of the English language.

The letters M's but real O's, etc. "meaningful" sequence can be inserted into the sentence, which constitutes a "words" which I am aware we are to PHYSICAL; and schemes come them, words, various proper names, and more "meaningful" anagrams for the form for the of serve various alphabetical mopeds per sequence.

Revised 1979

My serve of sections on mythology, sorority, mathematically, LEMMAS; the MAGMA, MATH with CAME, REAT, THETA, SL and more vicious adrenalinalytics sect: ATHLETICS, HEAT, HAM and MEASL proactive anagram.

For several number employed in the use of permutations scrambled cards by the sender.
The letters in MATHEMATICAL GAMES are not very typical: three M's but no N's, R's, or O's; four A's but only two E's and no O's, etc. My own estimate is that there are perhaps 3000 "meaningful" sequences of these letters (where punctuation and spaces can be inserted at will, and only fragments of ideas or phrases need be expressed), give or take a factor of 5. And even this estimate is sensitive to how strict or liberal we are with our notion of what constitutes "English". Thus, METAMAGICAL THEMAS consists of two "words" which are not in any standard English dictionary of which I am aware. METAMAGICAL is a Hofstadter coinage whose meaning we are to deduce by analogy with METAMATHEMATICAL and METAPHYSICAL; and THEMAS is an improper plural of THEMES. (Theme and scheme lead to themes and schemata; but from thema and schema come themata and schemata.) As we allow more and more foreign words, variant spellings, abbreviations, initials, contractions and proper names, the entropy of "English" increases, and we get more and more "meaningful" anagrams.

To illustrate what is possible, I have listed 100 "meaningful" anagrams of MATHEMATICAL GAMES. I have created a new literary form for this purpose, which I will call serve verse. An example of serve verse can be called a mope poem. A brief, self-referential mope poem is:

Reves: Sever verse, / Veers; serve.

My serve verse creation on MATHEMATICAL GAMES is divided into sections on the general themes of metamathematics, geology, zoology, sororities and athletics, culinary arts, and medicine. The metamathematics section is concerned with such things as THEMATIC LEMMAS; the geology section (or is it mineralogy?) with AMALGAMS, MAGMA, MALACHITE and STALAGMITE. The zoology section is obsessed with CAMELS and MAMMALS. The sorority section has GAMMA, ETA, THETA, SIGMA and CHI at its disposal, and seems to contain a vicious ad feminem attack against one EMMA GALE SMITH. The athletics section refers to TEAMMATES, GAMES, SETS, MATCHES and to ATHLETICS itself. The culinary section mentions STALE MEAT, STEAM HEAT, HAMS and CLAMS, and the medical section alludes to TEETH and MEASLES. Readers are encouraged to invent even more imaginative anagrams of their own.

For several centuries, one of the forms of cryptography actually employed to conceal the content of diplomatic messages was the use of permutation ciphers, where the letters of the message were scrambled according to a procedure known only (it was hoped) to the sender and the intended receiver. Without the correct rule,
as we have seen, the same letters might be unscrambled to reveal any "secret" message from MAGMA HEATS CLIMATE to SAM, THE MAG-IC TAMALE.

Mathematical Games
Thematic lemma saga
Meet math as magical
Magic sheet: lama mat
Image chats at lemma

Amalgamatic Themes
Amalgamate, chemist!
Chemist ate amalgam
Magma heats climate
Magi select mahatma
Malachite set magma
Stalagmite came, ham
Almagest: teach imam

This Camel Ate Magma
Get this, Ma'am: a camel
Tight as a camel, Emma
Camel meat? I'm aghast!
As a camel might mate
I get mahatma's camel
Castigate mammal, eh?
Cage atheist mammal
Tia cages the mammal
That's ice-age mammal
The camel's gait, Ma'am
Age maims that camel
Camel stigmata? Ahem!

Hag Claims Teammate
Chi Gamma's late mate
Asthmatic Emma Gale
Met me, claims Agatha
Gamma Chi stalemate

Mag's Mealtime Chat
Masticate ham leg, Ma
Chi Gamma: taste meal!
Stage claim: ham meat
Came as tamale might

Mama Mia! The Last Egg!
Aim, match, tag measles
Mica teeth amalgams

Metamagical Themes
I get the lemma - a scam
Elastic math game, Ma!
The same magical mat
G.1. lemmata schemata

The Magmatical Seam
Misamalgamate, Chet!
Alchemist ate magma
Mahatma's climate, e.g.
Michael, taste magma
Malaesthetic magma
Ah, magmatic Maltese
Megalith caste, Mama

Magma? Camels Hate It
Get this, ace: a mammal!
It aches? Get a mammal!
Aghast, Mac? Mealtime!
I get a chaste mammal
Che agitates mammal
Acetate mammal? Sigh!
Hattie cages mammal
I teach stage mammal
Mammal at "eighth aces"
The ice mammal's gate
Ice ages that mammal
Legit schemata, Ma'am

"Hate Mate," Claims Mag
Theta Gamma's malice
(Emma Gale Smith: a cat?)
Me? Clammiest Agatha!
Eta Chi Gamma metals

Mag's Calm Teatime? Ha!
Magic ham? Stale meat!
Teatime: ham, clam, gas
Malt, sage ethic, Ma'am
Sam, the magic tamale

Ethical, Sam? Get Mama!
I calm the stage-mama
Asthma: age claim met
Athletic Games, Ma'am
Michaelmas team tag
A late game mismatch
Claim gate at Thames
Aim, Al: game, set, match
Sham cage title, Ma'am
Met Lhasa magic team
Mime act: Hamlet saga
I match eaglets, Ma'am
Team game: Cal/Smith
Hit game castle, Ma'am

Thalamic Team Games
1 gash calm teammate
A lame gate mismatch
Time Malaga matches
Lit matches age Mama
Claim tag? Shame, team!
Act the lamains game
Ham act: get me salami
I tag the camel's mama
I get Tech's alma mama
Agile mama cast them

Editor's Note: One can ask what is the likelihood that any of the sentences given above have somewhere appeared in English writings in a meaningful (not wordplay) context. Obviously, this is a very stringent (and unverifiable) measure of the plausibility of an anagrammed phrase; it is quite possible that none of these phrases (save the already-noted METAMAGICAL THEMES) would pass. Put in other terms, it is not difficult for the reader to pick out the original phrase on which the anagrams were based. Cryptographers using permutation ciphers would be well-advised to select a message using convoluted grammar, with an anagram that sounds more plausible than the intended message.

OMNI GAMES

This paperback anthology of the best brain-teasers from the last five years of Scot Morris's Omni magazine Games column is devoted to an amazing variety of subjects: besides the usual mathematics and logic puzzles, it contains physics problems, geographical oddities, electronic calculator tricks, barbets, juggling, and a tribute to Martin Gardner. The emphasis is on (1) problems that look difficult but can be solved easily with the proper insight (aha!), (2) problems that look easy but contain hidden traps, and (3) problems that look difficult and in fact are, but which lead to curious facts. Though many problems are golden oldies, Scot Morris writes about them in a lively and entertaining way reminiscent of Martin Gardner, and often succeeds in bringing in new angles. The book is enriched by reader comment and emendations to the original Omni material. A substantial part of the book is devoted to problems related to logology: four unsolved Enigma-style conundrums by Bishop Wilberforce, the Beale cipher, two tough spelling quizzes, the "world's hardest" word quiz (containing much Word Ways material), mnemonics, rebus, anagrams, and the first crossword puzzle. The book is available from Holt, Rinehart and Winston for $11.95. Let's hope that this is the start of a long series.