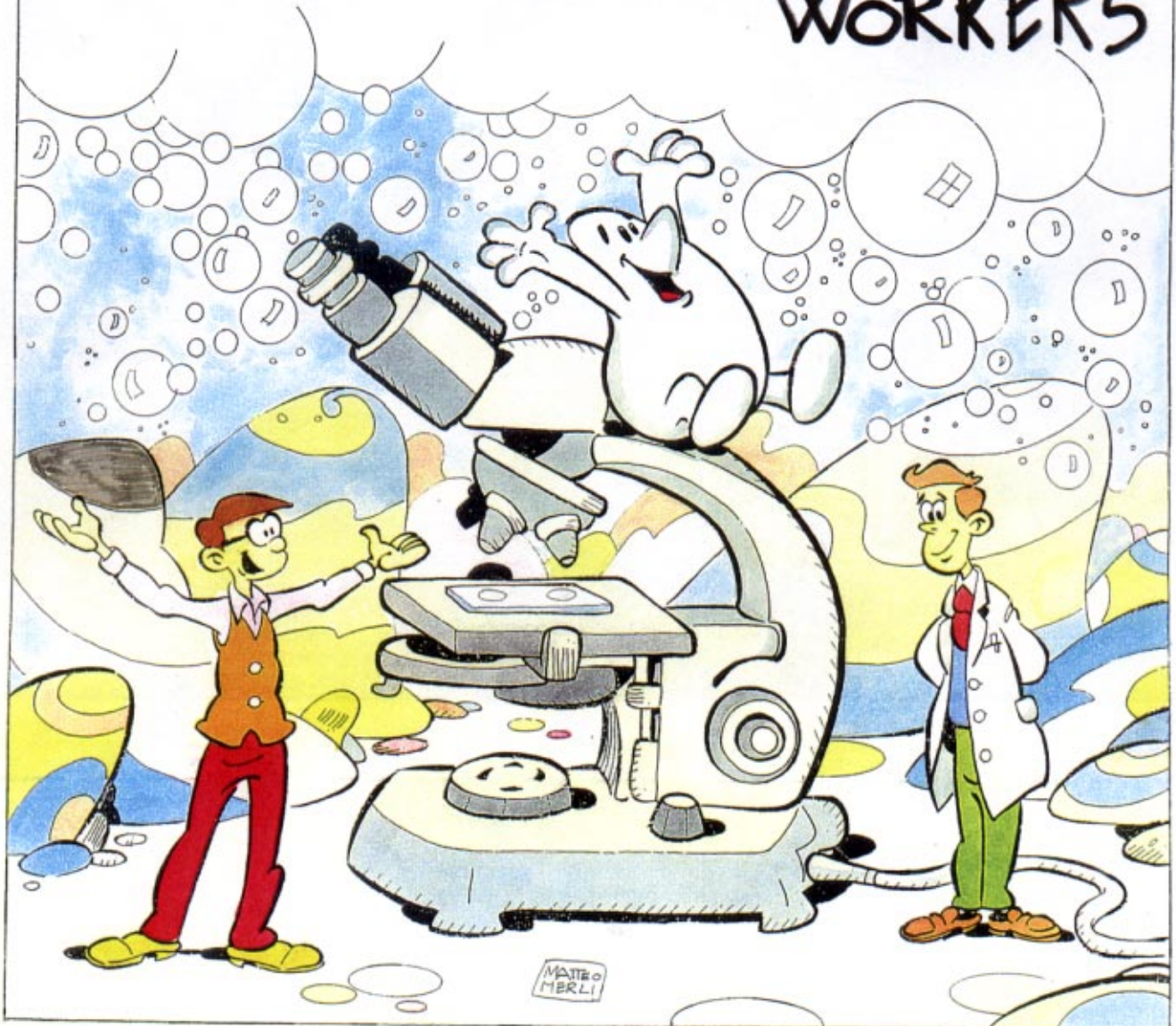


SACCAROMICHO

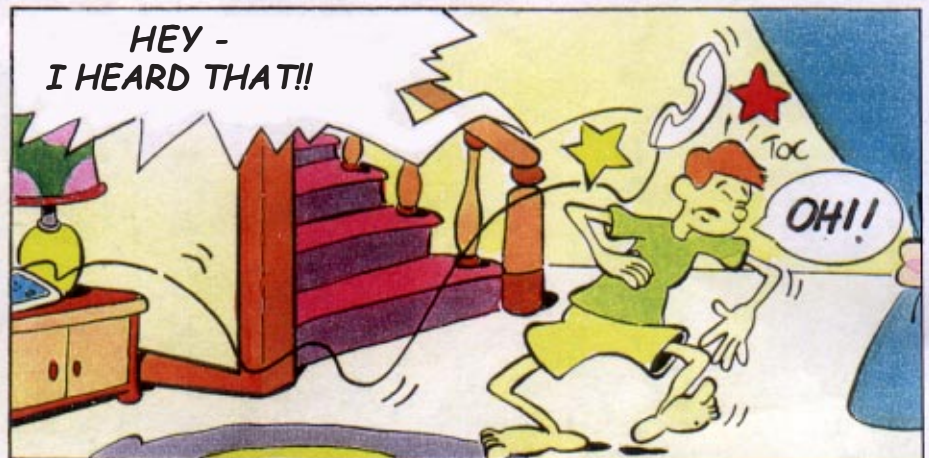
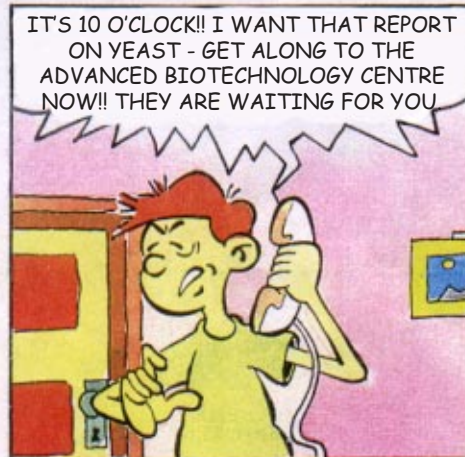
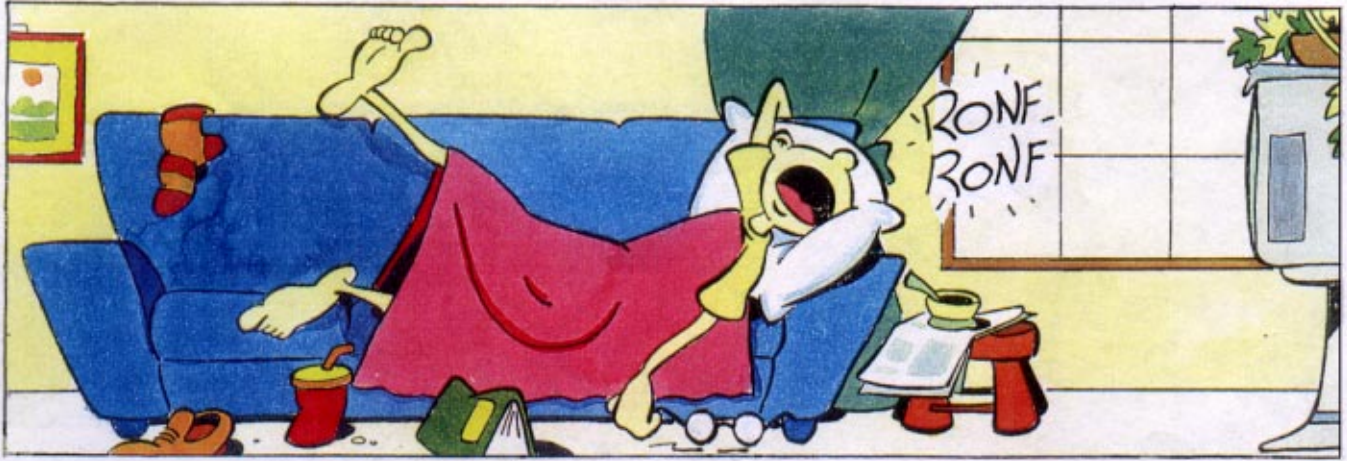
AND

THE INVISIBLE

WORKERS

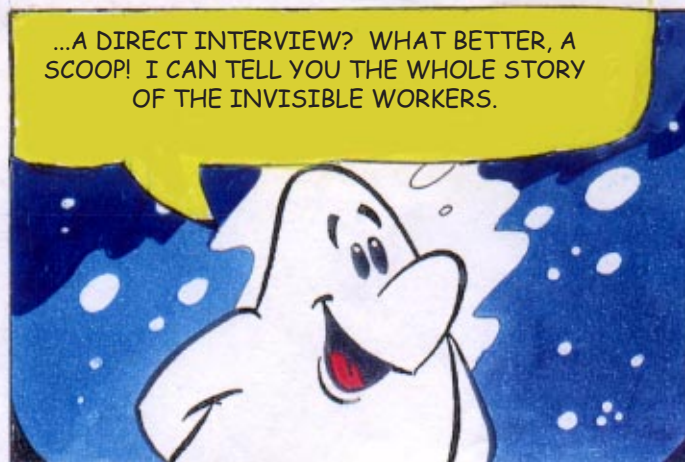
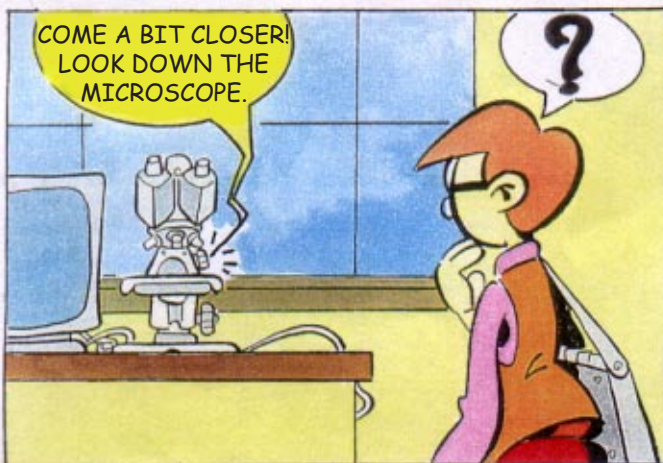
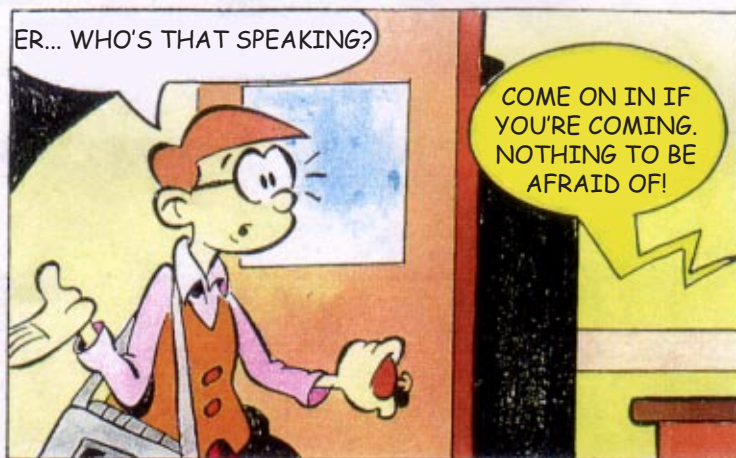


TEXT AND SCRIPT: STEFANIA UCCELLI, ALESSANDRA CORDA MANNINO, MATTEO MERLI
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 DRAWINGS: MATTEO MERLI ENGLISH TEXT: CAROLINE SHEARER

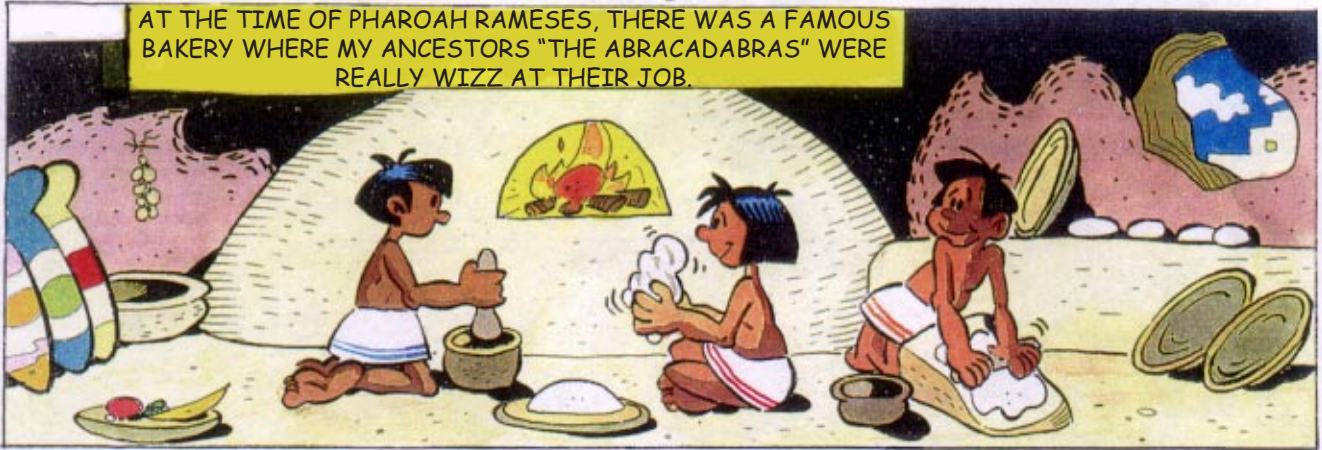


LATER... YAWN, HERE GOES, I HOPE I'M NOT TOO LATE. HUH, WORKING ON A SUNDAY MORNING, I CAN'T BELIEVE IT! JUST BECAUSE MY BOSS WANTS A REPORT ON THE HISTORY OF YEAST BY TOMORROW.



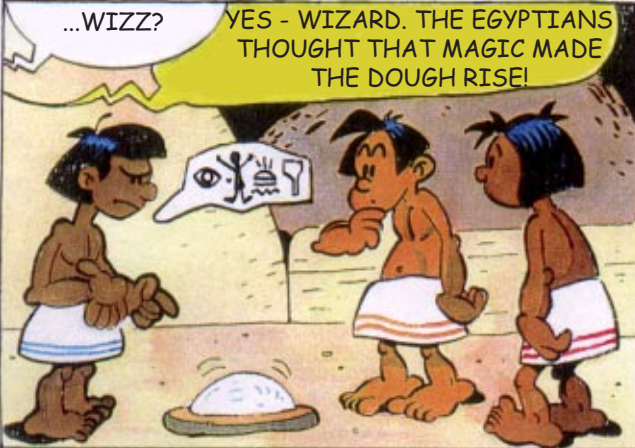


AT THE TIME OF PHAROAH RAMESSES, THERE WAS A FAMOUS BAKERY WHERE MY ANCESTORS "THE ABRACADABRAS" WERE REALLY WIZZ AT THEIR JOB.



...WIZZ?

YES - WIZARD. THE EGYPTIANS THOUGHT THAT MAGIC MADE THE DOUGH RISE!



FOR A LONG TIME FERMENTATION WAS BELIEVED TO BE DIVINE INTERVENTION AND SO WAS NOT INVESTIGATED ... NO ONE KNEW IT WAS THE SKILLS OF MY ANCESTORS THAT MADE THE BREAD RISE!



OH REALLY! AND HOW DID YOUR ANCESTORS MAKE THE BREAD RISE?



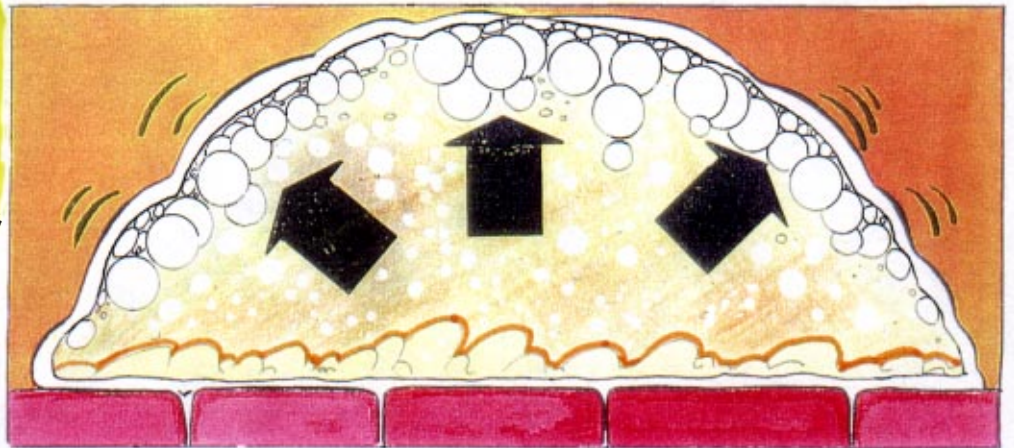
JUST LIKE I DO, LET ME EXPLAIN. WHEN THE DOUGH WAS LEFT TO REST, MY ANCESTORS LIVED OFF THE STARCH IN THE FLOUR AND MULTIPLIED FAST! THE BIOCHEMICAL PROCESS THEY MASTERMINDED - CALLED FERMENTATION - HAD THE EFFECT OF MAKING THE DOUGH RISE....



LIKE MY ANCESTORS, MY TALENTED FAMILY PRODUCE ENZYMES WHICH CAN BREAK DOWN THE STARCH IN FLOUR TO THE SUGARS MALTOSE AND THEN GLUCOSE - WHICH WE CAN LIVE OFF. BUT OUR REAL TALENT IS TO USE SUGAR TO PRODUCE CARBON DIOXIDE & ALCOHOL!!



TAKE A CLOSE UP LOOK AT A LUMP OF DOUGH ... THE CARBON DIOXIDE BUBBLES GET TRAPPED IN THE DOUGH. WHEN IT'S BAKED, THE ALCOHOL EVAPORATES BUT THE CARBON DIOXIDE BUBBLES EXPAND, MAKING THE BREAD SOFT.



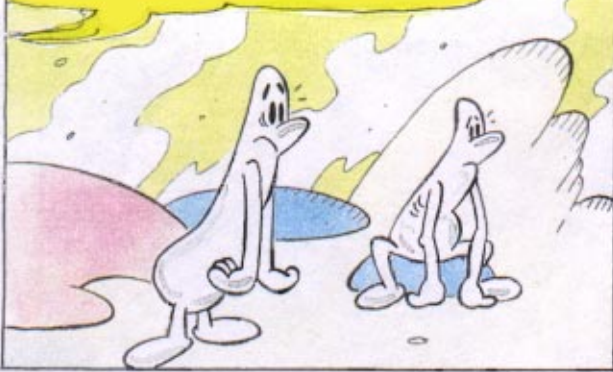
FERMENTATION STARTS SLOWLY, WE NEED TIME TO GET THAT STARCH BROKEN DOWN TO GLUCOSE AND TO GET GOING ON SOME SERIOUS REPRODUCTION SO THAT THERE ARE ENOUGH OF US WORKERS...THEN WE REALLY PICK UP SPEED!



ENOUGH OF THAT, NOW MEET SOME MORE OF MY ANCESTORS

WOW! WHAT A STORY.

SOME OF MY COUSINS - "THE LEAVENERS"
WORKED WITH THE HEBREWS



THEY ALWAYS WENT RATHER HUNGRY OVER
PASSOVER TIME, POOR THINGS, WHEN THE
HEBREWS MADE UNLEAVENED
BREAD...

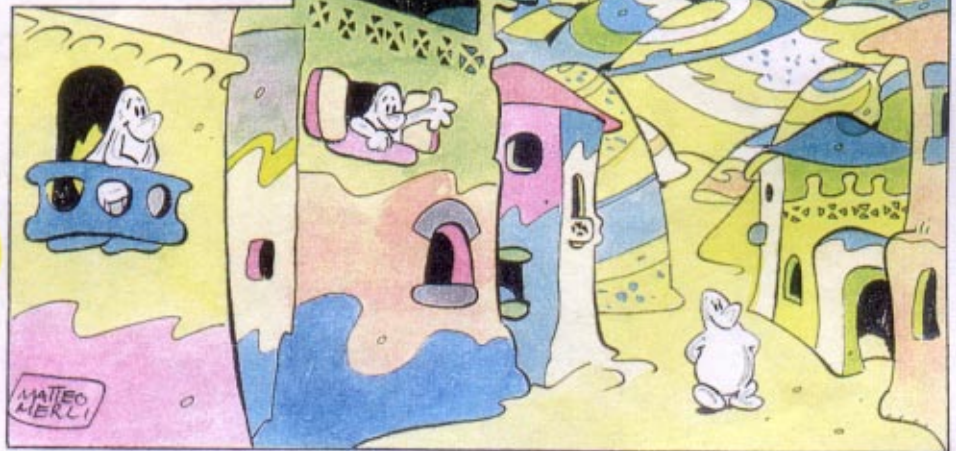


UNLEAVENED BREAD?



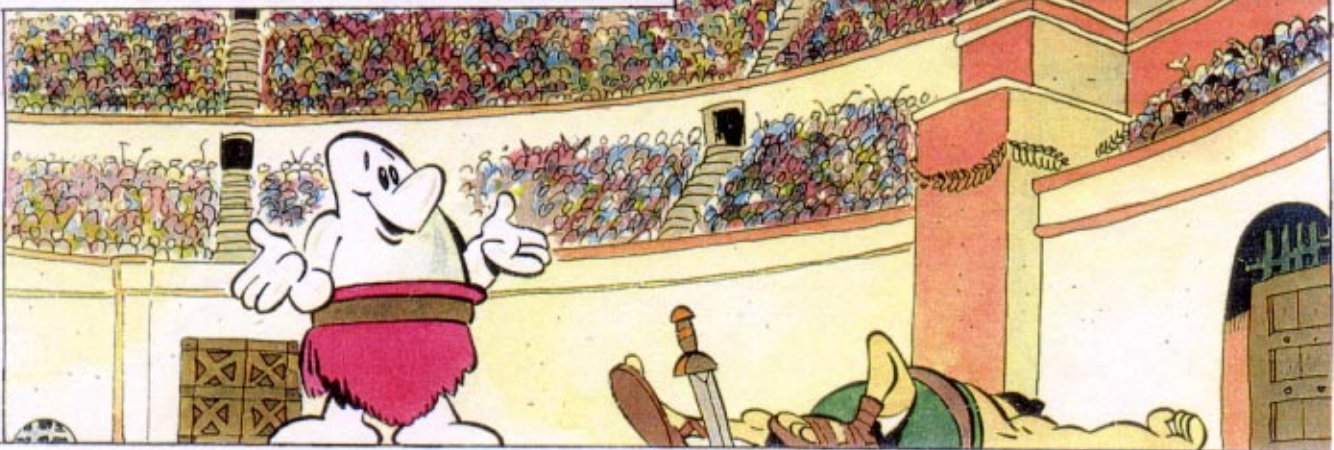
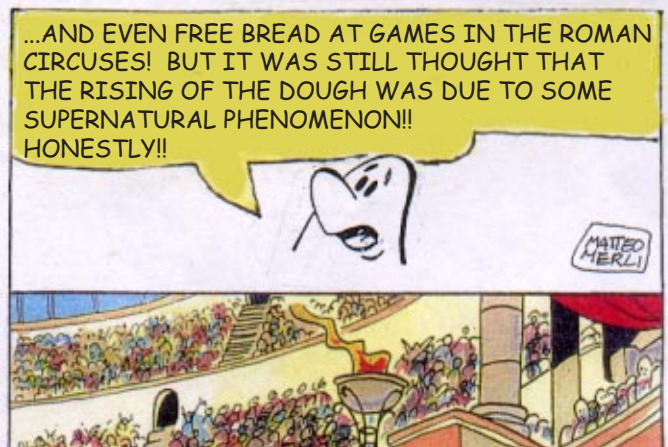
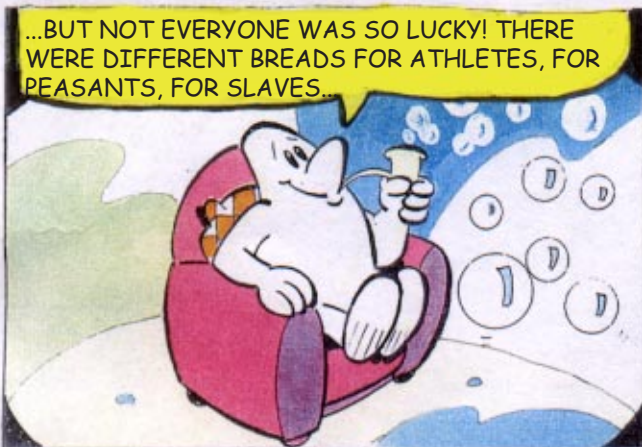
YEAH, A REMINDER
OF THE RUSHED
PACKING WHEN THEY
HAD TO FLEE EGYPT

THE GREEKS, ON THE
OTHER HAND, REALLY
GOT BREADMAKING
ORGANISED - THEY HAD
COMMERCIAL BAKERIES
AROUND 400BC. MY
COUSINS "THE RISERS"
HAD A HARD JOB KEEP-
ING THEM HAPPY....



...THE RISERS WERE EXPECTED TO WORK ALL NIGHT LONG
MAKING MANY DIFFERENT SORTS OF BREAD... NOT THAT
ANYONE RECOGNISED THEM FOR THEIR TALENTS!







WELL, WHERE WAS I? AAHUUH. UNTIL ONE DAY IN 1673 WHEN A DUTCH CLOTH MERCHANT CALLED VAN LEEUWENHOEK, A KEEN RESEARCHER IN HIS SPARE TIME AND AN ACE LENS GRINDER, MADE A MICROSCOPE THAT COULD MAGNIFY 200 TIMES... WELL, THAT MEANT HE COULD SEE LOTS OF THINGS INVISIBLE TO THE NAKED EYE, AND ONE OF THOSE WAS US - THE YEASTS!!!



HOWEVER, THINGS WERE STILL A BIT MUDDLED AS AT THAT TIME THEY WERE CONVINCED THAT SOME LOWER ORGANISMS...



... LIKE INSECTS AND WORMS COULD ARISE FROM RUBBISH BY SPONTANEOUS GENERATION!



HANG ON, I DON'T WANT TO SPOIL YOUR STORY BUT DID YOU KNOW THAT BY THEN, IN 1668 ACTUALLY, REDI HAD DEMONSTRATED THAT LARVAE CAME FROM...



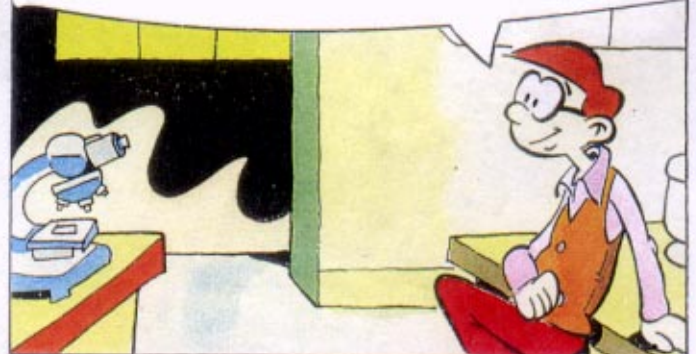
...MICROSCOPIC EGGS LAID BY FLIES. LATER OTHERS CONFIRMED THIS, WHICH RATHER UNDERMINED THE THEORY THAT ORGANISMS CAN ORIGINATE FROM DEAD SUBSTANCES.



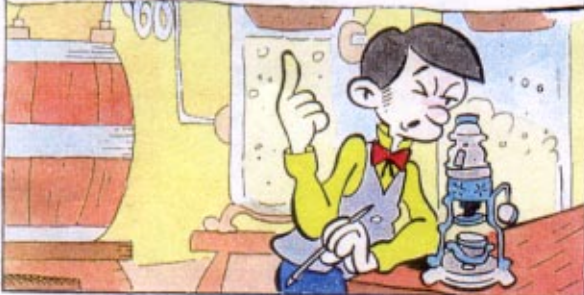
YES, I KNOW. BUT WHEN MICROBES WERE FIRST DESCRIBED - SOON AFTER REDI'S EXPERIMENTS - MANY RESEARCHERS STILL THOUGHT THAT THEY MIGHT ARISE FROM DEAD MATTER.



RIGHT, BUT LATER, IN 1765, ANOTHER ITALIAN, SPALLANZANI, MANAGED TO SHOW THAT EVEN MICROSCOPIC ORGANISMS COULDN'T ARISE...



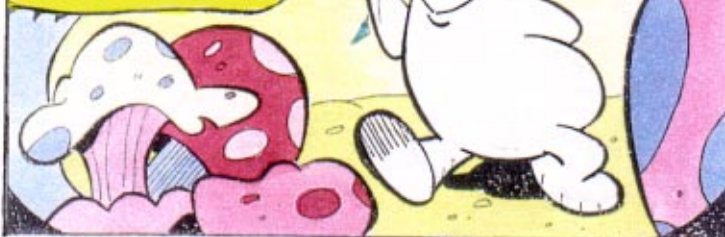
...FROM DEAD MATTER. HE ISOLATED A SINGLE BACTERIUM AND SAW IT DIVIDE INTO TWO! THE THEORY OF SPONTANEOUS GENERATION WAS FINALLY ZAPPED BY PASTEUR IN 1862.



AAH YES, PASTEUR... HE ISOLATED YEASTS AND LEARNED TO GROW THEM IN THE LAB. IT WAS PASTEUR WHO APPRECIATED THAT MY ANCESTORS WERE ABLE TO CONVERT SUGAR INTO ALCOHOL WITHOUT AIR.



IT WAS A START, ALTHOUGH IT TOOK MORE TIME FOR US TO BE RECOGNISED FOR WHAT WE REALLY ARE... NOBLY DESCENDED FROM THE ASCOMYTES AND CLOSE RELATIVES OF SUCH DELICACIES AS TRUFFLES AND MUSHROOMS.



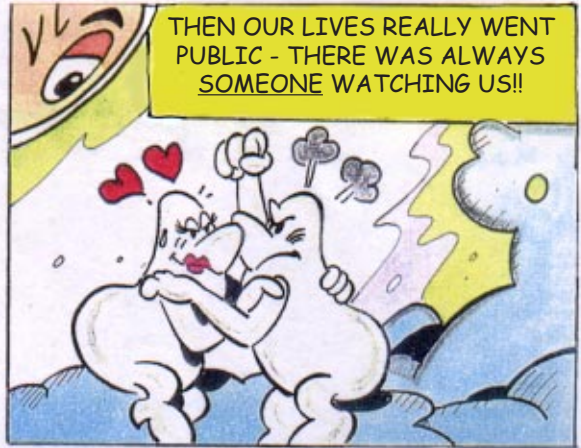
THE FRENCHMAN, CAGNIARD DE LA TOUR, A PHYSICIST OF ALL THINGS, STUDIED US VERY CLOSELY INDEED... IN MICROSCOPIC DETAIL... VERY ATTENTIVELY...



...WATCHING EVERYTHING... HE EVEN MANAGED TO SEE US ...AHEM... REPRODUCING!!! IN 1835 HE FINALLY DECIDED THAT WE WERE LIVING - "THE DARK SPOTS ARE ALIVE!"



THEN OUR LIVES REALLY WENT PUBLIC - THERE WAS ALWAYS SOMEONE WATCHING US!!



IN 1897 WE WERE GROUND UP WITH FINE SAND BY BUCHNER, A KEEN GERMAN CHEMIST. THAT PARTICULAR SACRIFICE ENABLED BUCHNER TO EXTRACT A JUICE WHICH HAD SOME OF OUR CATALYTIC ABILITIES - IT WON HIM THE NOBEL PRIZE FOR CHEMISTRY. BUT AT LEAST SOME OF OUR TALENTS WERE BEGINNING TO BE RECOGNISED.



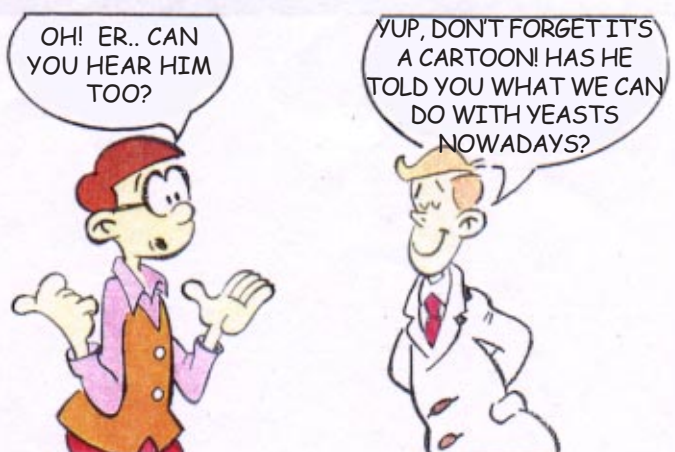
CHATTERING AGAIN?

HI! WELCOME BACK.



OH! ER.. CAN YOU HEAR HIM TOO?

YUP, DON'T FORGET IT'S A CARTOON! HAS HE TOLD YOU WHAT WE CAN DO WITH YEASTS NOWADAYS?



DETAILED STUDIES HAVE MADE US REALISE THAT THEY HAVE EXTRA-ORDINARY ABILITIES...



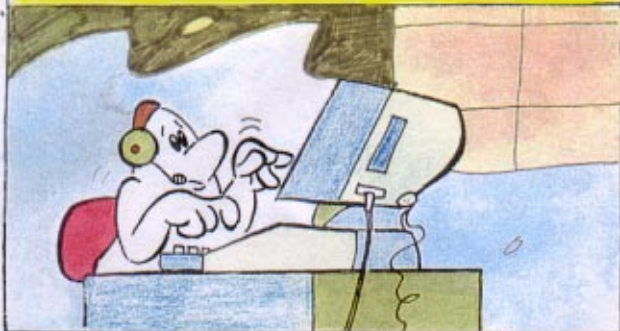
...AND MADE US WONDER HOW TO EXPLOIT THOSE ABILITIES!



YES, THEY DISCOVERED THAT IF THEY GIVE US GOOD CONDITIONS - PLENTY OF SUGAR AND OXYGEN...



...WE CAN REPRODUCE AND WORK FAST - ON AN INDUSTRIAL SCALE- AND THAT THE BEST OF US, THE REALLY SKILLED WORKERS, CAN PRODUCE A VERY FINE BREAD!



HOW DO YOU SELECT THE BEST?

NO PROBLEM. WE ISOLATE NATURAL YEAST STRAINS - FROM GRAPES OR BREWING - AND CHECK OUT THEIR ABILITIES.



SOME OF US GIVE BREAD A GREAT TASTE, SOME MAKE MORE CARBON DIOXIDE OR LESS ETHANOL, SOME ARE MORE RESISTANT TO FREEZING...



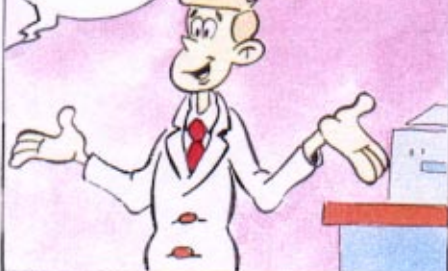
HEY! WHO'S TALKING HERE?



AS I WAS SAYING, WE SELECT STRAINS WITH THE CHOSEN TALENTS...



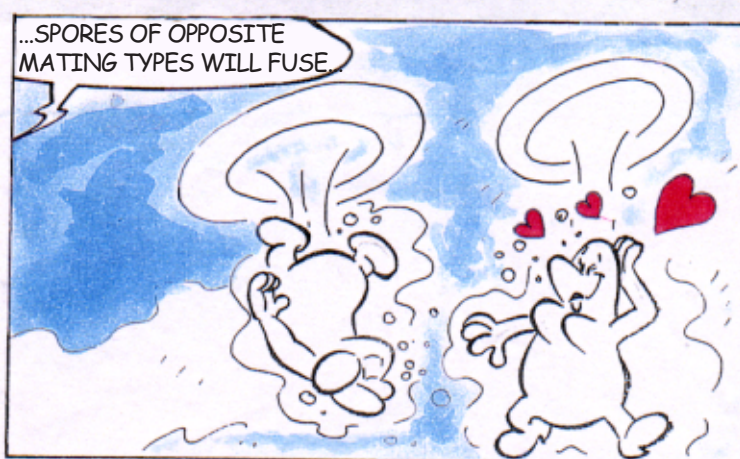
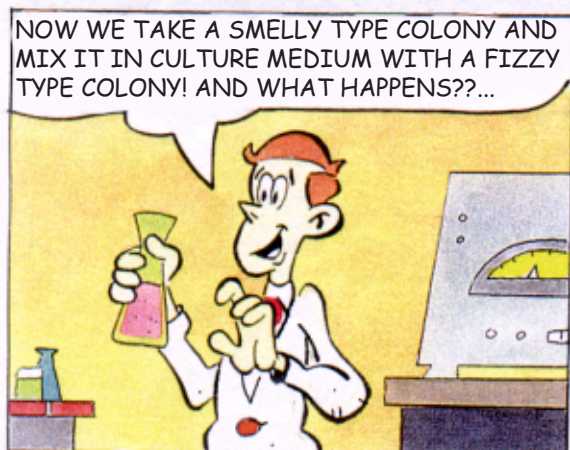
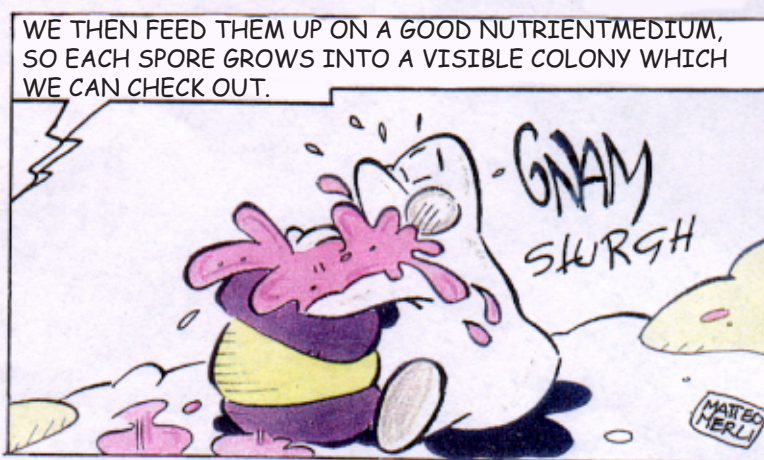
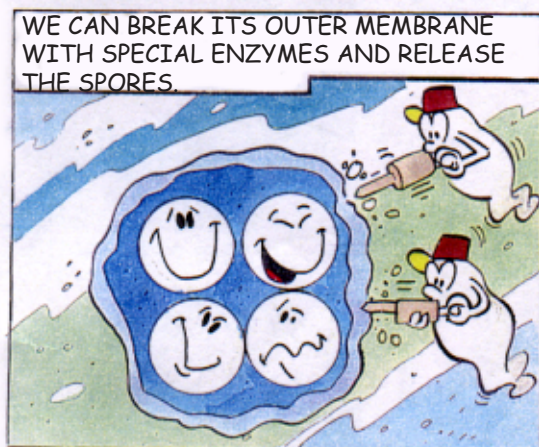
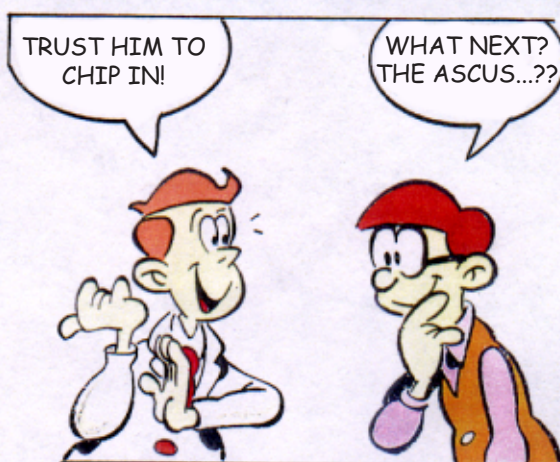
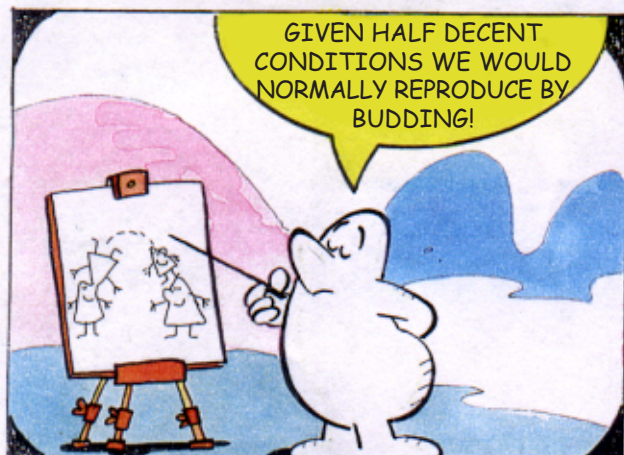
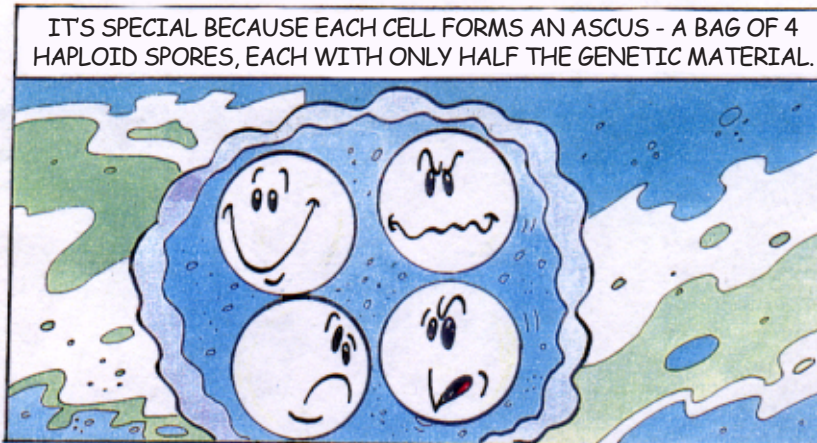
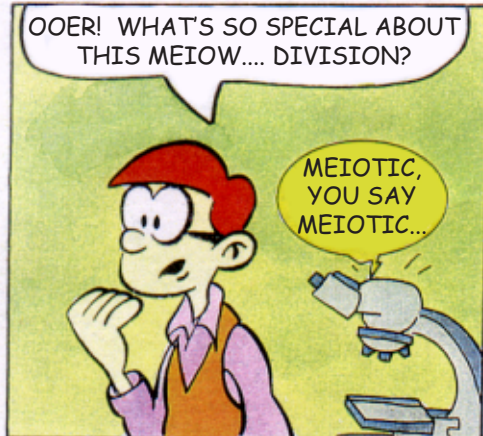
SO HOW DO YOU DO THAT?



...AND IN THE LAB WE GROW THE CHOSEN STRAINS.

WELL, TAKE THESE TWO - A.SMELLY AND B.FIZZY - EACH IS GROWN IN A PETRI DISH ON A SPECIAL (STARVATION) MEDIUM TO ENCOURAGE MEIOTIC DIVISION...





...AND ZYGOTES (DESCENDANTS)
WILL FORM THAT ARE NEW HYBRIDS
- SMELLY/FIZZY



SO?



WE HAVE A STRAIN
WITH BOTH TALENTS!



ALL THIS JUST FOR
BETTER BREAD?



JUST!!! SHOW SOME
RESPECT FOR TALENT!

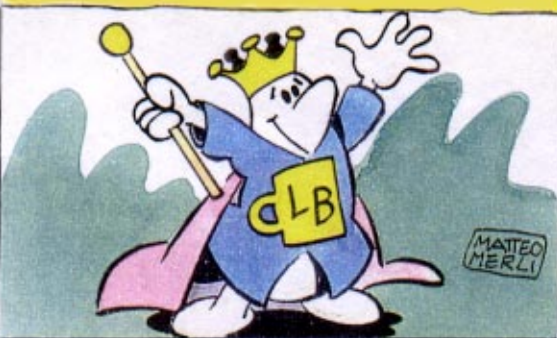


SORRY! I
DIDN'T
MEAN TO....

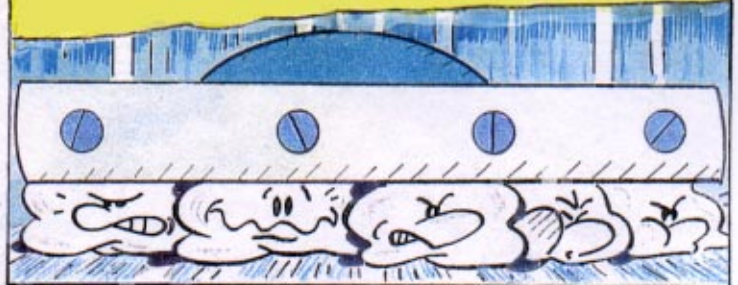
LET ME SPELL OUT OUR SKILLS FOR YOU
AND MAYBE YOU WILL SHOW A LITTLE
MORE RESPECT!



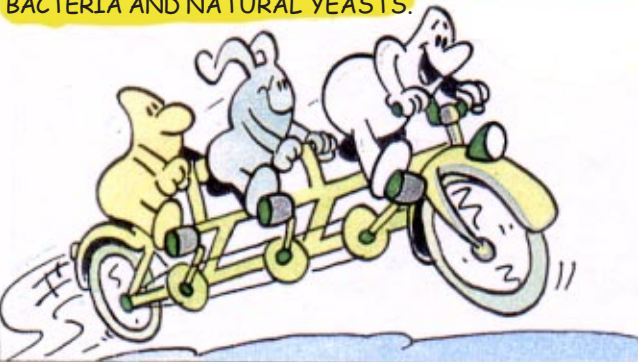
WE ARE THE STAR PLAYERS OF THE BIG
BAKERIES - KNOWN BY OUR STAGE NAME:
BAKERS' YEAST...



...REALLY WE ARE CAREFULLY SELECTED STRAINS OF
SACCHAROMYCES CEREVISIAE, GROWN UNDER
SPECIAL CONDITIONS TO GIVE MAXIMUM YIELD. THEN
WE ARE PRESSED INTO SLABS AND SENT FRESH TO THE
BAKERIES.



WHERE WE ARE WARMLY WELCOMED AND MIXED WITH
FLOUR AND WATER INTO DOUGH. HERE WE WORK IN
TANDEM WITH LACTIC ACID
BACTERIA AND NATURAL YEASTS.



UNFORTUNATELY, WE DON'T LIKE TOO
MUCH HEAT.... SO THAT WHEN IT COMES
TO THE OVEN....

